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IN THIS ISSUE:

WHERE THE PETROLEUM GOES
WONDERS IN STEEL FORGING

# SCIENTIFIC AMERICAN

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*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

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JUL 8 1920

HUMAN SPIDERS AND THEIR WEB: PAINTING THE CABLES OF BROOKLYN BRIDGE

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# FIRST
## *in*
# STABILITY

BEHIND a truck investment, as behind a financial investment, you need STABILITY of value most of all. Without it you have no investment. Without it your purchase is an uncertainty. The White Truck has many different values in and behind it, but they all can be summarized in the one word STABILITY.

***Stability of the Maker:*** The White Company is the foremost truck maker in this country, solidly built up and steadily expanded, with resources and an organization which make for continued leadership in the industry.

***Stability of Policy:*** Since the first White was built, the company has never deviated a hair's breadth from a fixed policy: to build trucks that will do the most work for the least money.

***Stability of Product:*** White Trucks have stood up and kept going day after day, year after year, in all kinds of service and under all sorts of operating conditions. There are a few records of 500,000 miles; a number of 300,000 miles; more of 200,000 miles and many of 100,000 miles, with the trucks still in daily service.

***Stability of Quality:*** Regardless of the cost of material, the quality of White Trucks has been unvaryingly high grade.

***Stability of Price:*** During the past five years White prices have increased a mere fraction of the average advance in truck prices. Expanded output and steadily improved manufacturing efficiency have stabilized both quality and price in the face of increased costs of labor and material.

***Stability of Ownership:*** The Annual Roll Call of White Fleets in actual service, listing owners of ten or more Whites, has no parallel in the truck industry. It is graphic proof of the most remarkable truck ownership in America; as remarkable for the quality of the ownership as for its extent and steady growth from year to year. The Roll Call contains the names of three hundred and fifty concerns with a total of 12,674 Whites. All together there are 3,691 White Fleets comprising 40,919 trucks, exclusive of single-truck installations.

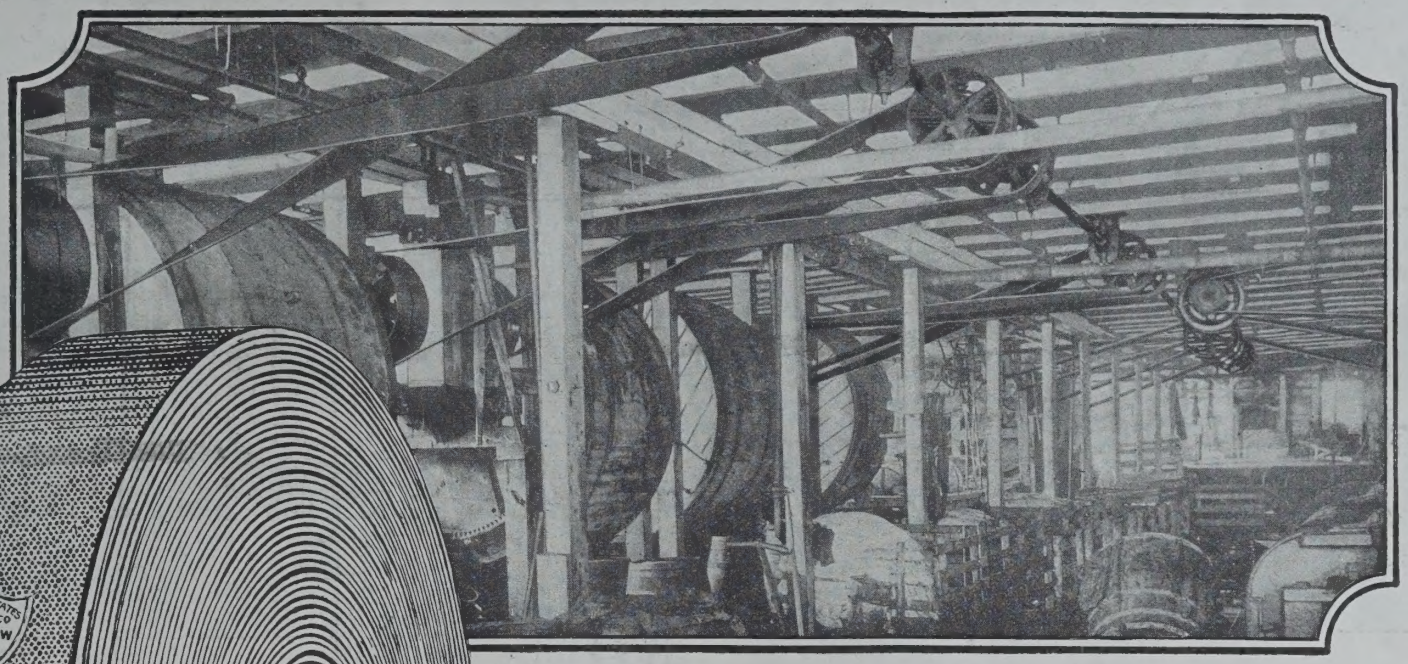
***Stability of Service to Owners:*** White Service facilities have been built up step by step to keep pace with an expanding distribution of White Trucks. This growth has required years of development, and an investment of millions.

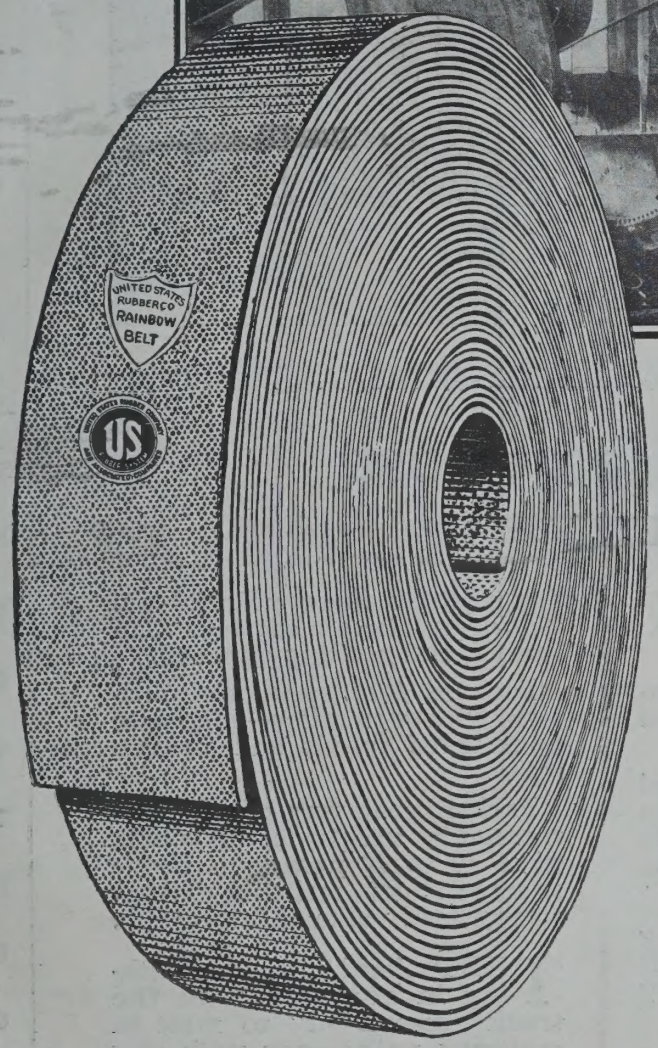
***White Trucks are an Investment*** of recognized earning power, backed by a responsible truck manufacturer with years of successful experience, thousands of trained employees, tens of thousands of trucks in active service, adequate capital and a nation-wide service organization.

THE WHITE COMPANY
CLEVELAND

# White Trucks

# RAINBOW
## FRICTION SURFACE BELTING






## Tanneries are Adopting Rubber Belting

This tannery beam room is equipped throughout with *Rainbow Friction Surface Rubber Belts.* The loads are heavy and intermittent—the speeds slow, 1500 to 3000 feet per minute—the place damp and sloppy. There is a shifter on each machine.

Two years' trial—not snap judgment, not a tempting price nor a salesman's argument—was the determining consideration. Performance under the most trying conditions of belt service won preference for *Rainbow Belts.*

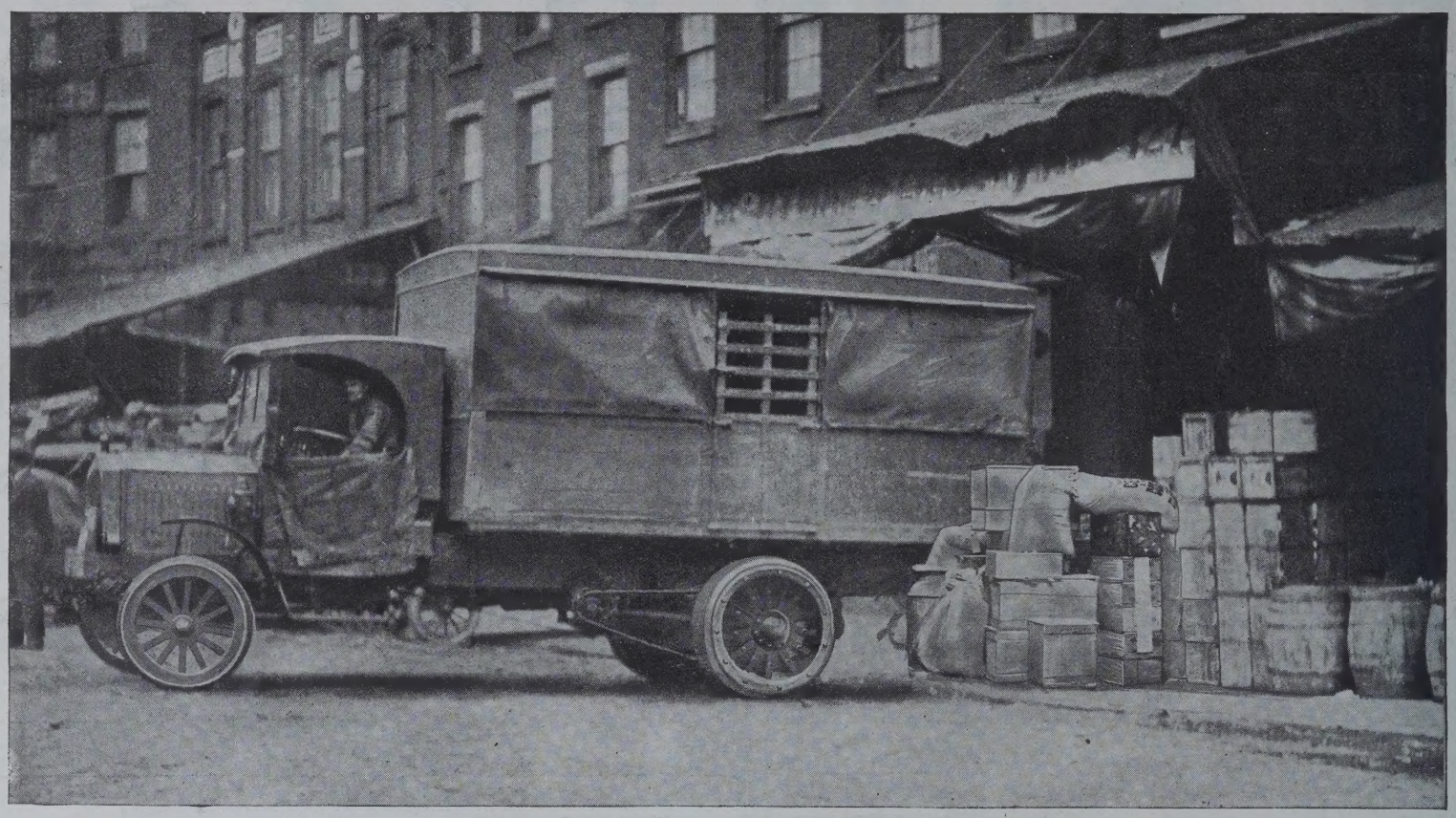
If you have a belting problem, put it up to our representatives and engineers. They will study it and make complete recommendation, covering the style, ply and size to give lowest belt costs per year.

## United States Rubber Company

*The World's Largest and Most Experienced Manufacturer of Mechanical Rubber Goods*

| BELTING | HOSE | PACKINGS | MISCELIANEOUS |
|---|---|---|---|
| **Transmission** *"Rainbow," "Pilot" "Shawmut"–"Giant Stitched"*<br>**Conveyor** *"United States," "Grainster"*<br>**Elevator** *"Matchless" "Granite," "Grainster"*<br>**Tractor** *"Sawyer Canvas" "Little Giant Canvas"*<br>**Agricultural** *"Rainbow," "Bengal" "Grainster," "Sawyer Canvas"* | **Air** *"4810," "Dexter"*<br>**Steam** *"Rainbow," "Giant," "Perfected"*<br>**Water** *"Rainbow," "Mogul," "Perfected"*<br>**Suction** *"Amazon," "Giant"*<br>**Garden** *"Rainbow," "Mogul," "Lakeside"*<br>Also Hose for Acetylene, Oxygen, Acid, Air Drill, Auto Radiator, Car Heating, Air Brake, Gasoline, Oil, Hydraulic, Chemical, Coke, Creamery, Discharge, Vacuum, Sand Blast, Spray, etc. | **Sheet** *"Rainbow," "Vanda," "Paramo*<br>**Rod** *"Wizard," "Rainbesto," "Peerless," "Honest John," "No. 573" and hundreds of other styles in coils, rings, gaskets and diaphragms—*<br>**Usco Valves—**<br>THE RIGHT PACKING IN THE RIGHT PLACE | Mats, Matting and Flooring<br>Plumbers' Specialties,<br>Rubber Covered Rolls,<br>Friction Tape, Splicing Comp'd,<br>Dredging Sleeves,<br>Hard Rubber Goods,<br>Printers' Blankets, Tubing,<br>Soles, Heels, Jar Rubbers,<br>Moulded Goods |

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES



*Feeding a great city with the aid of the Motor Truck. Though only nine years old, this Packard Truck has seen several generations of ordinary trucks go to the scrap heap. There are many Packards still doing today the same work they started to do nearly fourteen years ago*

# What Does the Scrap Heap Cost American Business

OFFICIAL survey shows that American business put $408,311,585 into motor trucks last year, and will spend another $568,650,000 during 1920.

How much of this vast expenditure represents *net growth* in trucking facilities?

How much is simply *replacement* of trucks bought only two or three years ago?

You can get out of a truck just what the builders put into it—and *no more.*

THE Packard people are primarily *transportation engineers.*

The basis of the Packard Truck is *unified engineering*—not merely a blue print and specifications of commercial parts; but Packard engineering design and Packard control of every Packard part.

Packard frames of *rolled* channel steel—not commercial pressed steel.

Packard live axles of special steel, *heat-treated* in furnaces designed by Packard. Tensile strength—220,000 pounds to the square inch.

Packard Engine both *strong* and *simple.* Four crank shaft bearings, as against the ordinary three.

*One* cam shaft only, and but *three* timing gears, in the Packard.

All valves *enclosed*, with automatic lubrication.

Packard clutch and universal joints *enclosed.* The clutch of dry multiple disc type, with *extra-large* clutch surfaces. No leather, and nothing exposed.

Packard *four-speed* transmission, with *even* ratios—as against only three speeds and uneven ratios.

Packard gears *forged* and *heat-treated* by *unique* methods that give 10 to 20 per cent. above average shock resisting ability, steady load value and long life.

THE Packard Truck has nothing in common with the truck "assembled" to meet an arbitrary price—nor with that built on the "exclusive" one-at-a-time idea.

It is built and sold on the business-like basis of *assured transportation returns* every day—an enduring *net gain* in your trucking facilities.

*"Ask the Man Who Owns One"*

PACKARD MOTOR CAR COMPANY, *Detroit*

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SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 1 ] NEW YORK, JULY 3, 1920 [ 15 CENTS A COPY $5.00 A YEAR

For each section of the country the diagrams refer the output of other petroleum products to that of kerosene, showing how many gallons of the other liquid fractions are obtained for every gallon of kerosene recovered

**How petroleum constitution and petroleum treatment vary from State to State**

## Where the Petroleum Goes

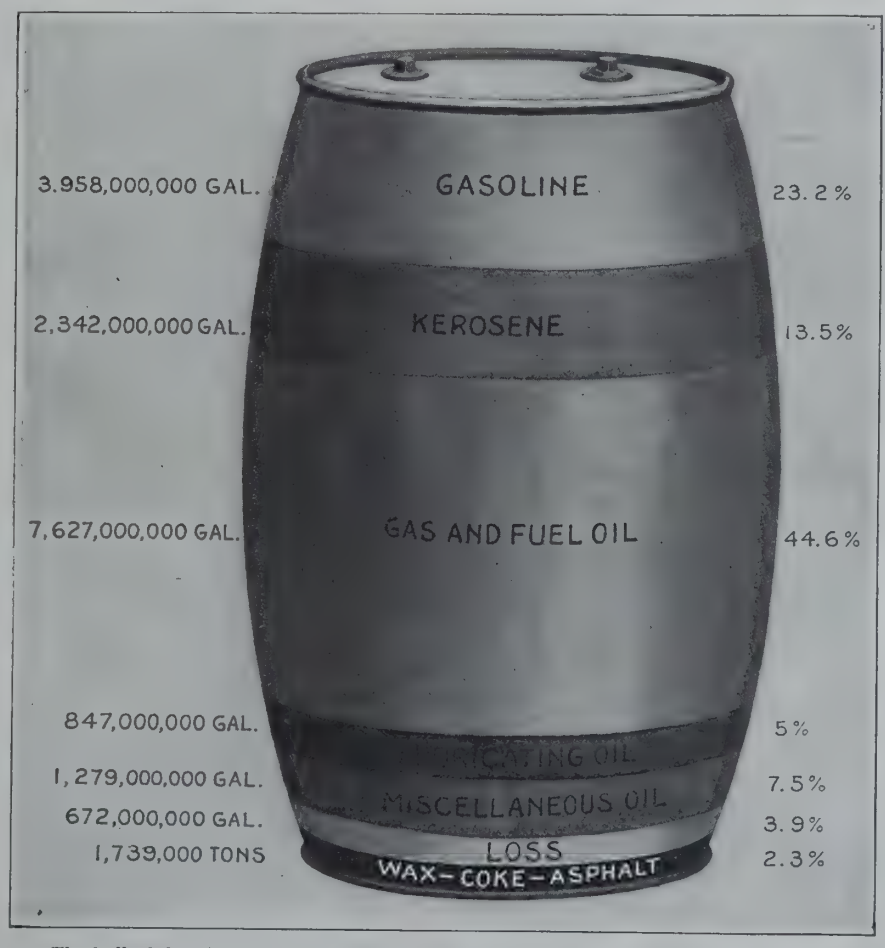
**By J. Malcolm Bird**

SOME weeks ago we discussed the gasoline situation from the viewpoint of sources of supply, showing as well as we could just where the petroleum comes from. But we pointed out in that article that gasoline is only one of the products of the petroleum refinery; it is therefore in order to ask and answer the further question "Where does the petroleum go?"

Individual refiners hesitate to answer this question. A given refinery deals with petroleum from a single section of the country, and employs a given process of extraction which is determined in part at least by the immediate market within easy shipping distance of the refinery. Thus one refinery may run heavily toward the recovery of one fraction, sacrificing others to this one; while another establishment may exactly reverse this choice. For it is to be emphasized that the refining of petroleum is not the sort of process that leads to a unique and inevitable result, like the sorting out of tall and short persons from a crowd. Within very wide limits, what we get out of our crude oil depends upon what we do to it; even more it depends upon the grade of the oil—another variable with very wide limits of its own. So when you ask the owner of one refinery or even of one large group of refineries to estimate what the United States makes out of its petroleum each year, he will throw up his hands and explain that the most he can do is to tell you what he makes out of *his* petroleum, and that he does not want to do that for fear that you will make the very mistake of supposing this to represent some sort of rough general average for the entire country.

The Bureau of Mines, however, presents figures which show the aggregate bulk of petroleum treated in the United States for each year, and the aggregate of each product recovered. These figures automatically represent American practise as a whole, and it is to them that we turn for the material for the present discussion. The first thing that they tell us is that the refiner was not "spoofing" us when he pleaded that his showing meant nothing for the country at large. For instance, the refineries of the east coast get only 11 per cent more gasoline than they do of kerosene out of their crudes. But for the Colorado and Wyoming refineries, the gasoline extraction exceeds that of kerosene by no less than 261 per cent. And the other sections into which the petroleum industry divides the country make showings that fall at various levels between these two extremes. So there is no joke at all about the statement that crude oils differ, and that the only way to see what a given oil will yield is to try it out.

**For the United States as a whole, gasoline, fuel-oil and lubricating-oil production compare with kerosene output as here indicated**




The bulk (left) of each major fraction; and the percentage (right) by volume which it constitutes of all petroleum treated

**Where Uncle Sam's petroleum goes**

The kerosene fraction is taken as the standard of comparison here and in the drawing that elaborates upon this aspect of the situation merely because it is the fraction most closely bound up with the history of the industry, and because at the same time it comes about as close to being present in constant proportion as any other constituent—though this approach to uniformity is by no means a narrow one. Referring the three other principal products to kerosene in this way, we see that for the entire country we extract 1.69 gallons of gasoline for each gallon of kerosene that the crude oil yields—the sectional showings, as we have just seen, varying from 1.11 gallons for the Atlantic Coast to 3.61 gallons for the Colorado-Wyoming field. For the fuel-oil and gas-oil group, the general performance is 3.26 gallons for each gallon of kerosene; Pennsylvania petroleum is the leanest in these fractions, yielding only .88 gallon for each gallon of kerosene, while California makes the prodigious showing of 11.28 gallons of the heavy oils to one of kerosene. American crudes as a whole yield .36 gallon of lubricating oil for each gallon of kerosene; the Colorado-Wyoming field with .05 gallon and the Pennsylvania refineries with .95 gallon representing the extremes. So it is quite obvious that we can make no generalization as to the per cent of gasoline, kerosene, etc., in petroleum; all we can say is that petroleum contains these constituents, in proportions that must be determined in each individual case.

If we cannot make any generalization with regard to the constitution of petroleum, however, we can safely assume that the grand total of the American output of crudes is substantially the same from one year to the next. Over a period of years this would not be a safe supposition, since one field gets worked out and new ones are opened up; but from one year to the next, the percentage of hydrocarbons that will distil over up to a given tempera-

(Continued on page 20)

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Railroads the Foundation of National Prosperity

ASK the average man what is the material asset upon which the prosperity of the United States is founded and he will doubtless mention agriculture. Theoretically, he would be right. Modern civilization, however, particularly the mechanical side of it, has so greatly modified conditions that it may well be questioned whether in the United States, with its vast distances, the railroads do not take equal rank with agriculture as the foundation upon which our industrial and financial well-being is built up.

In the earliest times, as today, subsistence and wealth came out of the soil; but life in those days was very much a hand-to-mouth matter, and it was only as civilization developed that consumption of the fruits of the earth, whether in food or materials, took place at any distance from the source. This development has progressed to the point where the local consumption is absolutely insignificant, and practically the whole of the fruitage of the earth, whether in wheat, coal, oil, metals or what not, is carried to the four corners of the earth for consumption. Particularly is this true of the United States; and it is no exaggeration to say that our great railroad systems are not merely the foundation of our national prosperity, but are inextricably interwoven with the whole fabric of our daily life.

How closely the prosperity of the railroads is related to the prosperity of our great industries was forcibly brought home to the editor during a recent extended trip through the Middle West and the Northeastern states. In establishment after establishment we heard a story which ran somewhat as follows: "We are overloaded with orders. We have all the labor we require, and in the main it is contented and satisfactory. But our operations are limited by the scarcity of cars and the general let-down of transportation. We are able neither to obtain the necessary raw materials nor to ship the finished product." Evidence of the literal truth of these statements was to be seen in the general depletion of stockyards at one end of a works and in the congestion of finished products awaiting shipment at the other end.

So far as legislation is concerned, the most effective plan for the Government to follow in assisting to bring back normal conditions would be immediately to give every possible assistance to the railroads in making good the serious shortage of locomotives, cars and general equipment. Above all, effort should be made to build, with all possible speed the greatly needed freight cars. Until the shortage has been relieved, we may try every possible means to bring back normal conditions without avail. The cry for increased production is futile, since the railroads are not able to handle even the present output.

An analysis of the condition of our railroads, which we published in January, showed that under normal operation they require about 2,000,000 tons of steel rails per year, whereas in two years, the Railroad Administration had purchased directly only 200,000 tons of steel rails. Annually, the railways require about 100,000,000 new ties, but apparently, under Federal control there will be a shortage of about 25 per cent, or say 50,000,000 ties. During the four years prior to Federal control, the railways built an average of 100,000 freight cars per year, whereas the Administration had purchased only 100,000 freight cars in two years of which only 90 per cent had been delivered. Moreover, during the past two years, freight equipment had not been maintained in normal condition. It is estimated that about 200,000 new cars must be built in 1920 to make good the deficiency. The same story of shortage had to be told with regard to locomotives. The normal requirements are about 3,000 new locomotives per year. Yet during Federal control, only 2,000 locomotives, or one-third of the normal requirement have been provided.

It is one of the marked futilities of human nature that it is ever prone to give its attention to the things remote, and overlook those which are pressing for attention close at hand. Truly, a prophet is not without honor save in his own country—and amid the thousand and one nostrums that have been shouted at the dear people in the effort to get matters straightened out, we are hearing far too little about the one outstanding and supremely important question of the era—namely the rehabilitation of our great railroad systems.

## The Scientific Value of Speed Contests

IN all great sporting contests in which high speed is the deciding factor, many people, in whom the critical faculty is developed at the expense of others equally valuable, make themselves audible in protest against the sacrifice of strength and durability which is necessary in producing a first-class racing machine, be it airplane, yacht or automobile. "What is the sense," they ask, "of building a contraption which, if it should be so fortunate as to hold together for one supreme effort, has no further use in the broad field of sport and pleasure?"

An off-hand answer to this question would be to remind these gentlemen that sport is sport; that the craving for high speed is a protest against the natural inertia of things; and that, if a man does not possess in his veins the good, red blood to which speed as an element of sport appeals, it is more his misfortune than his fault, and he is to be pitied rather than blamed. But, as a matter of fact, the ardent pursuit of speed in racing machines has reacted most favorably upon the mechanical arts. The race course is a very practical, man-sized kind of laboratory, where the products of the labor of the designer at his drafting board are given a gruelling test, during which the one weak link in the chain, if there be such, is certain to be disclosed. The great value of the construction and competition of racing machines is that we gain in knowledge of the dynamic as compared with the static stresses. Static stresses can be determined with great accuracy, and the testing machine gives us equal accuracy in determining the strength of materials; but in driving an automobile at a racing speed, and even more in smashing one's way with an oversparred and lightly-constructed yacht against short, snappy seas, there are dynamic stresses developed, the exact strength and effect of which no man can foretell through the medium of theoretical calculations.

Moreover, racing has greatly stimulated the quest for materials that are light in proportion to their weight; and there can be no doubt that for the many wonderful alloys which are available in the constructive arts today we are beholden, not a little, to the craze for speed, with its demand for a maximum of strength with a minimum of weight. To think of the racing car is to think of aluminum, vanadium steel, and last, the wonderful molybdenum steel; and a retrospective survey of the America's Cup races calls to mind the hollow steel boom of "Valkyrie III," the Tobin bronze and aluminum hull of "Defender," the light but strong hollow wooden spars culminating in the great hollow mast of "Shamrock IV," and the tapered, hollow aviation spar which forms the topmast of "Vanitie," to say nothing of the aluminum gaff carried by "Resolute." A test case as to the industrial value of yacht construction is the three-ply mahogany shell of "Shamrock's" hull, which proved so tough and strong and water-tight that its designer built Government ships, during the war, of a thousand tons capacity, on this principle.

And to get away from man-made machinery, who shall measure the enormous benefit conferred by the centuries of effort to produce the thorough-bred race horse of today? So valuable has been this effort of man to coöperate with nature, that the last word of praise which we can give to a horse is to speak of the thorough-bred strain that runs in its blood.

## A Problem of Freight Distribution

IN a recent issue we referred to the proposed solution of the problem of freight distribution on Manhattan Island which contemplates the bridging or tunneling, or both, of the Hudson River for the purpose of bringing standard freight cars to the northern part of Manhattan Island and distributing them to warehouses and steamships by means of an elevated marginal railroad extending along the Hudson River waterfront. With such terminal facilities it would be possible for a freight car that was loaded at New Orleans, St. Louis, Chicago or San Francisco, to pass directly to a storage warehouse or a steamship on Manhattan without breaking bulk.

There is another scheme of distribution which involves a principle which has been receiving increasing recognition since the introduction of motor trucks, and which we believe is destined to be a powerful factor in solving the future problems of freight handling and distribution in such congested centers as Manhattan. We have in mind a plan which is sponsored by Colonel W. J. Wilgus, former Chief Engineer and Vice President of the New York Central Railroad Company, which contemplates the construction of a special system of small electrically-operated subways, similar to one already in existence and operating successfully at Chicago, for the delivery of freight directly to the basement floor of the consignee. Reference was made to this system in a paper read by Colonel Wilgus at a recent meeting of the New York section of the American Society of Civil Engineers, which is published in full in the July issue of the SCIENTIFIC AMERICAN MONTHLY. Colonel Wilgus disapproves of the plan for bringing the full-sized freight cars of the railroads onto Manhattan Island. He believes that inasmuch as somewhere in the metropolitan district there must be a transshipment of Manhattan freight from the standard railroad car to a distributing vehicle, it should not be done on costly property and among congested surroundings located as near as possible to Broadway. He believes it would be more economical and convenient to effect this distribution at the western road terminals on the New Jersey meadows, carrying the freight thus distributed to Manhattan by tunnel in trains of electrically-operated, small-unit vehicles. Distribution would be by way of small subways located near the surface, which would deliver these cars direct at, or into, the basements of the warehouses and manufacturing establishments of the consignees on Manhattan. Where delivery was not made direct by these electric freight trains, the containers holding the freight would be removed from the cars and placed on motor truck chassis for short radius "store-door" delivery. This principle of using standardized freight containers, which can be mechanically lifted from railway trucks and placed upon motor chassis, is already in successful operation in several localities, and there is no doubt that its extended application will prove to be highly economical in reducing labor costs.

The plan of bringing the full-sized railway freight cars by bridge or tunnel to a marginal railway on Manhattan is not antagonistic to the scheme of Colonel Wilgus for classifying freight in Jersey City for distribution by means of small electrically-operated freight subways. The one system would be complementary to the other, and there is room for both.

We have touched upon but one point only of this paper, which deals with the whole railway situation in its relation to the all-important question of pier accommodation. The author believes that every effort should be made to have the Dock Department enlarge the width and increase the rail and mechanical facilities of the 125-foot piers that are proposed at Staten Island. We commend the paper for careful reading, as being a complete summary of the transportation problem as affecting the interests of the leading seaport of this country.

## Engineering

**Hydro-Electric Possibilities in Transcaucasia.**—The next few years will witness a great development in the utilization of potential water power for electrical purposes in Transcaucasia. The mountainous character of the country and the proved mineral wealth are the two important factors that will make these undertakings commercially profitable. The total existing hydro-electric stations yield only 6,725 horse-power, although surveys have indicated that over 350,000 horse-power is possible.

**American Locomotives for Portuguese East Africa.**—The Lourenco Marques Railway has recently received eight American locomotives, five of the Santa Fe type and three of the Pacific type, and they have proved far superior to any of the foreign engines in use, according to a U. S. Consular report. The Lourenco Marques Railway connects the port of Lourenco Marques with the railway system of South Africa and is the most convenient route for imports into the region of which Johannesburg is the center.

**Rail-Creep on Railroad Bridges.**—The chief engineer of the Madras Railway has something to say regarding rail-creep on railway bridges in India, in a recent issue of *Indian Engineering*. In the case of the Godaveri bridge, where the creep amounted to as much as three to four feet a year, a special cast-iron sleeper was designed to suit the 75-pound flat-footed rail, with a jaw large enough to receive a lock-fast steel key. This reduced the creep to insignificance, and generally the author is confirmed in the conclusion reached by him in 1887 that "creep" can only be remedied by effective anchorage.

**Lumber Conservation.**—At last we Americans are thoroughly aroused over the seriousness of our lumber resources. For decades we have been cutting down our splendid forests with little thought of reforestation; for the past ten years a mighty host of periodicals and newspapers have been clamoring for thousands upon thousands of tons of paper each week, which has meant the cutting down of thousands of acres of splendid timber. With the advent of the great war, more forests were cut down to build the expansive cantonments, wooden ships, and other things. And now we are confronted with seriously depleted forests. Reformation and conservation are the subjects of the hour, for wood is something without which we can hardly get along. Other countries, not favored with the abundant forests which we have had in the recent past, have long exercised good judgment and care and reforestation in guarding their timber reserves. France, for instance, practises the greatest economy in the use of lumber. Most French farmers get along with the identical buildings of their great grandfathers. The annual consumption in France is not more than one hundred board-feet per capita, or less than one-third the quantity used by Americans.

**Consistency of Concrete.**—In an article appearing in a recent issue of the *Canadian Engineer*, H. E. Davis has much to say about concrete road construction. Among other things he deals with a simple method of checking the consistency or flowability of concrete so as to keep the water content of the mixture fairly constant. The question of correct consistency is, in most instances, treated with the proportioning of aggregates, as this combination results in the best concrete. Most engineers prefer dealing with the question of consistency first and allowing the question of proportion to be dealt with afterwards. A scheme that was used on certain work proved to be of great value in keeping the consistency constant. The method was to place a shovelful of green concrete at one end of an inclined board and note whether it would flow when the board was at the angle at which concrete of the best consistency should flow as predetermined by laboratory investigation. After heavy rains, stock piles absorb a considerable quantity of water, but with the scheme mentioned above it is quite easy to keep the same consistency throughout the work. It requires very little time to determine the right angle and the method has the advantage of keeping the water content of the mixture fairly constant and assists in placing and finishing.

## Science

**Endowment of the National Research Council.**—It is announced that the Carnegie Corporation of New York will place a fund of $5,000,000 in the hands of the National Academy of Sciences to be used as a permanent endowment of the National Research Council and to provide a building in Washington which will house both the Council and the Academy.

**A Scientific Conference on the Pacific.**—The Committee on Pacific Exploration of the National Research Council is planning the program of a scientic conference to be held at Honolulu next August, under the auspices of the Pan-Pacific Union, at which it is proposed to outline some of the fundamental scientific problems of the Pacific Ocean region and to formulate methods for their solution.

**Professor Pier Andrea Saccardo,** who recently died, was born at Treviso, Italy, in 1845, and during the greater part of his professional life was director of the Royal Botanic Garden of Padua. Saccardo's name is a household word among botanists all over the world, chiefly on account of his great work on the fungi, the Sylloge Fungorum, which has been in course of publication since 1882, the twenty-second volume having been published in 1913. Prof. Saccardo was, however, the author of much other important literature relating to mycology and other branches of botany.

**The Amundsen Expedition.**—According to *La Géographie*, the Norwegian Government has sent out a supporting expedition for Roald Amundsen's transpolar voyage. This supporting party, which is led by Lieut. G. Hansen, of the Danish Navy, who was with Amundsen in the voyage of the "Gjoa" in 1903-5, spent the past winter at Etah, in northern Greenland, and expected to leave in March with a dozen sledges for Cape Columbia. Amundsen planned to leave his ship, the "Maud," at the most northerly point attained in its drift, and travel over the ice to Cape Columbia, where he is likely to arrive in March of next year.

**Scientific Workers and the Income Tax.**—In Great Britain, where the income tax is an even more serious burden upon inadequately paid scientific workers than in this country, a committee representing the British Association of Chemists, the Institute of Chemistry, and the National Union of Scientific Workers is circulating a petition which will be presented to the Treasury, in favor of deducting various expenses incurred in scientific work from the amount of income on which the tax is computed. These expenses include subscriptions to scientific and technical societies and periodicals, purchase and renewal of apparatus and materials used in scientific work, rent and expenses of laboratories, etc., expenses incurred in attending scientific meetings, provision of special clothing for work and renewal of clothes damaged in the course of employment, and various other analogous professional expenses.

**Effects of a Reservoir on Rainfall.**—The U. S. Weather Bureau was recently asked by a foreign government for an opinion as to whether it would be worth while to construct a large reservoir for the purpose of increasing the rainfall in a subtropical arid region. Although such questions have often been considered before, the Bureau in this case made a study of the meteorological records of regions of the United States adjacent to large inland bodies of water. The cases considered were the creation of the Salton Sea, in California; the building of dams and the reservoirs formed thereby in Minnesota; and, finally, the probable influence of the Great Lakes on the precipitation of the Lake region. The rainfall records of Arizona show more rain, on an average, since the Salton Sea was formed, in 1906, than before, with the exception of the dry year 1910. The data are not, however, strictly homogeneous, on account of the increase in the number of reporting stations. Furthermore, the proximity of the Gulf of California, a body of water vastly larger than the Salton Sea, seems to vitiate the argument that the presence of Salton Sea has materially affected the rainfall of the region. In the case of Minnesota, the yearly averages for a period of 32 years do not show any progressive increase in the rainfall of the state. A consideration of the probable effect of the Great Lakes led to the conclusion that 2 or 3 inches of the annual rainfall might reasonably be ascribed to the moisture supplied by the Lakes.

## Astronomy

**Another Nova in the Andromeda Nebula.**—The seventeenth nova found in the Andromeda nebula is reported by Milton Humason in the *Publications* of the Astronomical Society of the Pacific, No. 185. It appears on plates taken at Mount Wilson last October, but is invisible in earlier and later plates. It is nearer the center of the nebula than any nova found in that area since the discovery of No. 1 in 1885 and in recorded maximum brightness exceeds all but No. 1.

**Solar Activity in 1919.**—According to a summary of this subject published in the *Monthly Notices*, R.A.S., it is now evident that the maximum of sunspot activity was reached in 1917. The lower average latitude of spots during 1919 and the decrease, both in the mean daily spotted area and in the size of individual groups, is strong evidence that the maximum has been passed. The year 1919 was, however, a period of great solar activity. The month of greatest spotted area was June, though on some days during March, May and August the maximum area of about 2,500 millionths was reached.

**Another Nova in Sagittarius.**—The systematic search that is being made for new stars on the Harvard photographic plates has yielded numerous discoveries, of which one announced March 10, 1920, is typical. A Harvard College Observatory bulletin says: "A new star, making the sixth in constellation Sagittarius, has been found by Miss Woods. The nova is not seen on a plate taken on July 24, 1905, which shows stars of about the twelfth magnitude, but appears on a plate taken on July 26, 1905, of mag. 8.8, and on July 27, of mag. 7.1. It is seen on ten plates taken in August of that year, but decreased rapidly in brightness until August 22, when it was mag. 10.0. It is not visible on recent plates. No spectrum of the star was obtained."

**Some Facts about Satellites.**—From an interesting summary of knowledge concerning the satellites of the solar system, by Dr. S. B. Nicholson, we glean several facts which are perhaps unfamiliar to many students of astronomy. The writer points out, for example, that, on account of our nearness to the sun, the moon is by far the brightest satellite, as seen from the surface of its primary, Jupiter's satellites are large (two of them are larger than Mercury) and some of them are quite near the planet, but their total light on Jupiter, even if all were in full phase at once, would be only one-third that of full moonlight on the earth. The outer satellites of Jupiter are so far from their primary that the perturbative action of the sun is very large; in fact, it may be shown that if it were not for their retrograde motions, Jupiter VIII and IX could not be permanently held by the planet. Perturbations change their orbits so much that it is almost impossible to think of them as orbits, in the ordinary sense. For instance, the eccentricity of Jupiter VIII had been known to change from 0.50 to 0.23 during two revolutions of the satellite. It is quite possible that Saturn and Jupiter have undiscovered remote satellites fainter than the 16th magnitude.

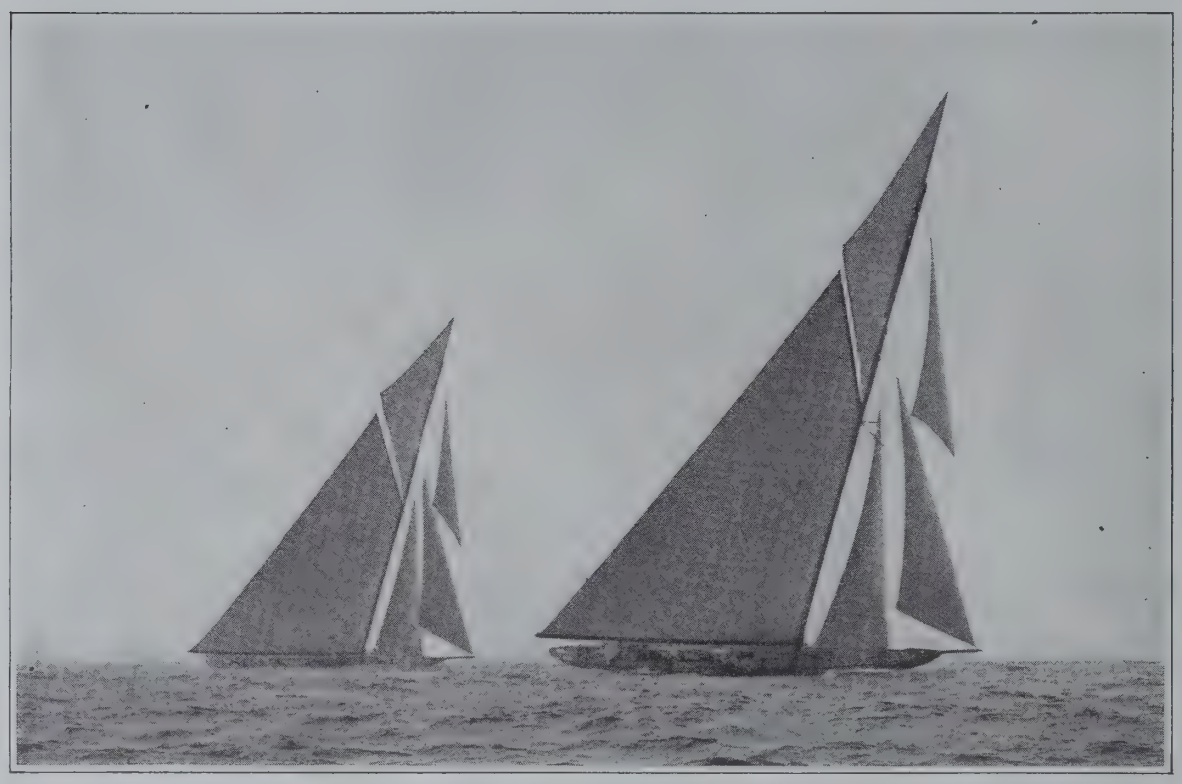
**New Method of Measuring Double Stars.**—Experiments have recently been made by Messrs. Pease and Anderson, of the Mt. Wilson observatory, in the application of Michelson's interferometer method to the measurement of close double stars. An apparatus was constructed with movable slits about 4.5 mm. wide and 25 mm. long, and this was installed about 117 cm. inside the Cassegrain focus of the 100-inch telescope. The diameter of the cone of light at this point being about 73 mm., the arrangement was such that the slits could be separated by this amount. The apparatus carrying the slits could be rotated about the optical axis of the telescope, for determination of position angle. The fringes of stars were observed through an eyepiece of 1 cm. equivalent focus. Much higher magnification is, however, desirable. The investigators report that the resolving power of the telescope for double stars is at least doubled by this method; that good "seeing" does not appear to be important, as the fringes were very sharp under poor atmospheric conditions; that very small angular separations can be measured with an accuracy at least as great as that for larger angles; and that the position angle can be determined as accurately for very close doubles as for those widely separated.

# Tuning Up for the Cup Races

## "Shamrock IV"—The Unknown Quantity Among Four 75-Foot Racing Yachts

By J. Bernard Walker

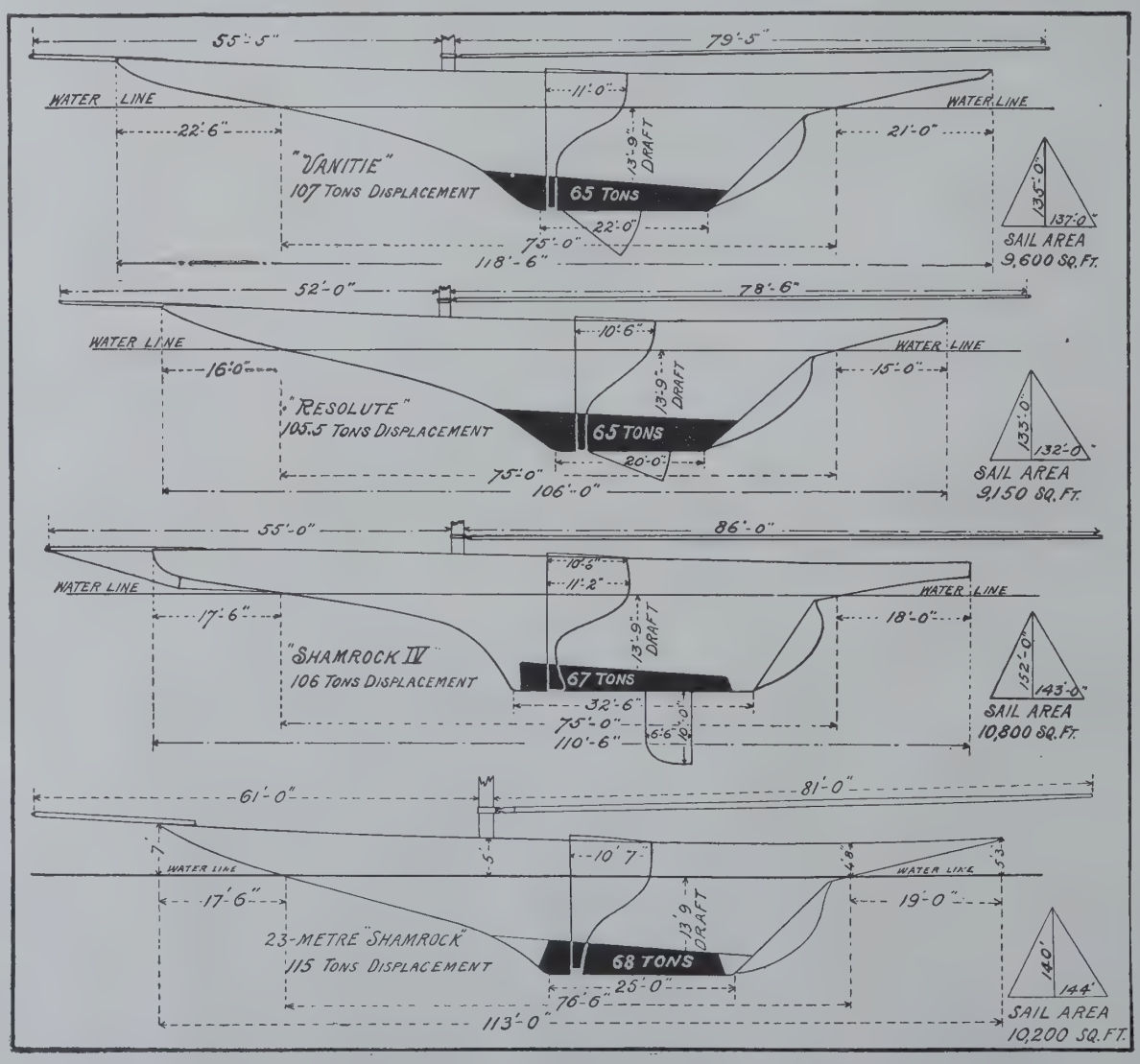
WHEN Sir Thomas Lipton made the very sensible suggestion that in view of the great cost of the modern 90-foot racing yacht, the cup contests for 1914 should be sailed with yachts of 75-foot waterline length, he introduced an uncertainty as to the comparative speed of the 1920 challenger and defenders, which has added a strong spice of interest to the contests. For it is nearly two decades since we had a 75-foot class, and therefore we have nothing on this side of the water that has tried conclusions with the British twenty-three meter (75.4 feet) yachts, which were raced so hard and continuously in European waters in the years preceding the war.



**"Vanitie", right, and "Resolute", left, beating to the outer mark during a windward and leeward trial race for selecting the defender of the America's cup. Note the great reach of the clubtopsail above the topmast (30 feet in "Vanitie") giving the effect of a Marconi rig**

We have good reason to believe, however, that both the defending and the challenging boats are phenomenally fast. "Vanitie" and "Resolute," thanks to their narrow and lofty rig and the refinement of their hulls, are nearly as fast, boat for boat and under equal conditions, as the old 90-footers—certainly they would have no difficulty in saving their time allowance; and "Shamrock IV," judging from the ease with which she pulls away from the twenty-three meter "Shamrock," is undoubtedly herself a very fast boat. But of that, more anon.

This element of uncertainty is answerable, in great part, for the fascination of yacht racing, and it is in full force in the 1920 series for the American Cup. Take, for instance, the battle royal which has been going on between "Vanitie" and "Resolute." "Billy" Gardner (as his host of friends know him) had shown down through the years that he was no mean antagonist for the redoubtable Herreshoff; and when Mr. Cochrane gave him an order for the 75-foot "Vanitie," there was great interest to see what he could do in producing a large out-and-out racing craft of America's Cup type. In the trial races of 1914, "Resolute" established an undoubted superiority, which was repeated and, indeed, emphasized in the trials of 1915. It was believed, however, that "Vanitie" suffered from indifferent handling, and that changes in her sail plan would serve to develop the speed that lies in her well-turned hull. So this year her mast was lengthened two feet, and changes were made in the direction of giving her sail plan greater height in proportion to its base. She was furnished with an entirely new set of Ratsey sails, and she now carries as perfect a suit as the most captious critics could wish to look upon. The changes in hull consist of the removal of the eight-inch rail, thereby saving a thousand pounds of top weight, and also a veneer deck, similar to that first displayed by "Shamrock" in 1914, was substituted for her pine deck, with the result that another 2,000 pounds was eliminated. Altogether, alow and aloft, some 3,500 pounds of weight has been saved, and this was placed, as inside ballast, low down in the hollow keel. The result of these changes, coupled with the excellent handling which she is now receiving from Rear-Commodore Nichols of the New York Yacht Club, has been magical. Of the eight races which have been sailed at the time of writing, five have been won by "Resolute." But of these one should be ruled out because it was a mere drifting match, and in another "Vanitie" was beating "Resolute" badly to windward, when her centerboard fouled a lobster pot, and she dragged several fathoms of line and part of the gear with her, thus slowing the boat down considerably. Of the other six races, three have been won by "Vanitie" and three by "Resolute." It is considered by the committee that the most impressive work by "Vanitie" was done in the eighth race, when, with the advantage of a twelve-knot breeze, she beat the Herreshoff boat handily some two minutes in six miles of windward work.




**Midship section and outboard profile of the 23-metre "Shamrock," shown in comparison with "Shamrock IV" and the two cup defenders "Resolute" and "Vanitie"**

Thus far, the "Vanitie" seems to be master of "Resolute" in winds of from twelve knots upward. In the lighter winds, particularly in drifting matches, "Resolute" seems to have the edge on the Gardner boat. Evidently the Race Committee will have its work cut out in selecting the defender. "Resolute" has the advantage that the challenger will have to allow her one minute and thirty seconds more than she would have to allow "Vanitie"; on the other hand, "Vanitie," both in hull and rigging, seems to be the more robust and reliable craft—a matter which must needs carry considerable weight with the committee in determining which boat to send out to the Sandy Hook course to meet the redoubtable "Shamrock IV."

We know that whichever craft is chosen, the Cup will be defended by an exceedingly fast boat, and the question naturally arises—how fast is "Shamrock IV"? Apparently she will spread from 1,200 to 1,600 square feet of canvas more than her competitor, and, judging from her performance in these waters, she seems well able to carry her lofty rig. The only means of getting a line upon her speed is by comparison with the twenty-three-meter "Shamrock," and in this connection, it is interesting to study her midship section and profile

as shown in the accompanying comparison of the four 75-footers.

The twenty-three-meter boat was built under the International Rule, which was drawn up with a view to getting away from the extremely light construction of the racing yachts of the earlier years of the present century, and producing a vessel combining "habitability with speed." The rating of the yachts under the International Rule is determined by adding the water line length to the breadth; plus half the girth measured at 0.55 from the bow end of the water line; plus a factor, d, which is the difference between the chain girth and the skin girth at the same point, plus one-third the square root of the sail area minus the freeboard. The water line length, it should be noted, is modified by a consideration of the girth at the bow and the stern ends of the water line.

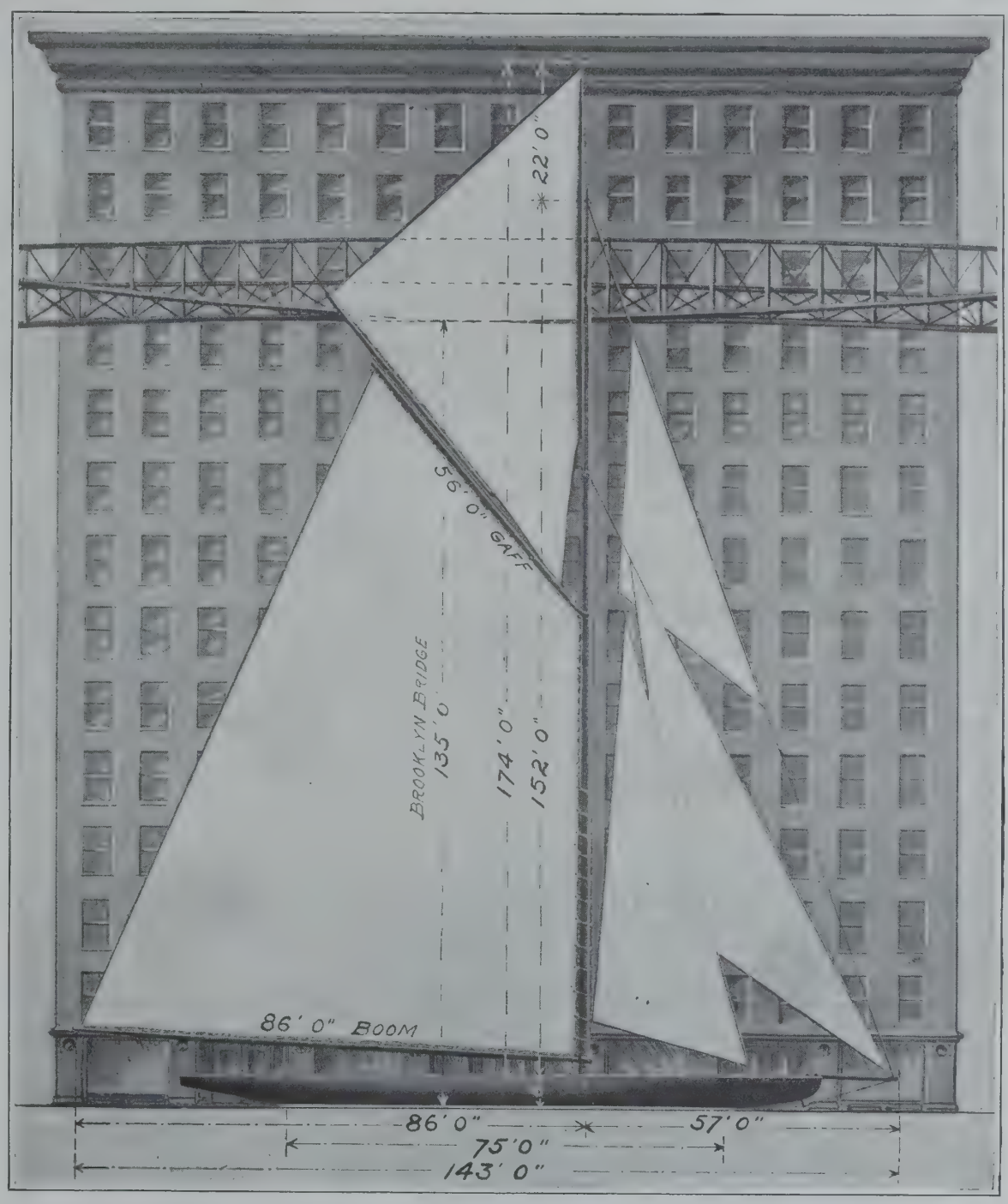
The object of this rule, as in the case of the American rule under which the present races are being sailed, was to produce a deep-bodied boat with fairly sharp and easy ends. But the International Rule goes farther than we do, by prescribing the strength of the scantling and requiring that all yachts must be built under the survey of one of the three classification societies, Lloyds, the German Lloyds, or the Bureau Veritas. Under this rule, the boats have to carry solid masts and must be fitted with complete cruising accommodations. All of the leading countries, with the solitary exception of the United States, adopted this rule, and many fine yachts were built under its restrictions. Among these was the 23-meter "Shamrock," which took the water in 1912 and proved to be the fastest vessel of her class. She was built by Fife, and, like all of his boats, is an exceedingly handsome craft.

The all-important question just now is—how fast is the older "Shamrock"? It will be seen from the accompanying diagram that she is nine tons heavier in displacement than "Shamrock IV" and nine and one one-half tons heavier than "Resolute." The extra weight is easily accounted for by the fact that she has a solid mast weighing two and one-half tons, that she has sixty-eight tons of lead ballast, and that she is a thoroughly equipped cruiser below deck, with staterooms, galley, accommodations for the crew, and every convenience required for comfortable cruising. She has a sweetly turned hull, which should be easy to drive. Like all of the International Rule boats, she carries a large sail spread, the topmast truck being 140 feet above deck. The length from tip of bowsprit to end of boom is 144 feet, which is a foot more than the same measurement on "Shamrock IV" and twelve feet more than on "Resolute."

As to the speed of the twenty-three-meter craft, we know that she swept the boards in British waters in 1912, and the records show that in winning the Queen's Cup off the Isle of Wight, she sailed the forty-eight-mile course in exactly four hours at an average speed of twelve knots. This, however, may not have been as good as it seems, for the reasons, first, that the course is laid in the sheltered waters to the north of the Isle of Wight, and secondly, that the tidal currents are very swift, and it is quite possible for a yacht to have a four-knot current in her favor on certain legs of the course. A more reliable measure of her speed was obtained by Captain Diaper, who brought her across the Atlantic. He tells us that her best sailing, as measured by patent log was 11.7 knots for two consecutive hours. This was done under her greatly reduced ketch rig and in a heavy reaching wind and following sea.

Now "Shamrock IV" is a faster boat than the older craft to windward, as was shown in the first trial race off Sandy Hook, when she pulled out a lead of eight minutes and fifty-eight seconds in a beat to windward of ten and one-half miles. This she duplicated in the second trial race, when she gained 9 minutes in 10 miles of windward work. In reaching she does not do nearly so well, since in the same race she beat the older boat only fifty-one seconds in a close reach of eight and one-quarter miles. Down the wind with spinnaker, she pulls away from the older boat, but not in any such fashion as when they have sheets aboard in a thresh to windward. The yachting "sharps" of the daily press seem to think "Shamrock IV" is oversparred. On the other hand, designer Nicholson, after her first trials, removed several tons of lead because she was too stiff in light airs.

All things considered, there is reason to believe that this will be the closest contest for the Cup ever seen on the famous Sandy Hook course. As in the case of "Shamrock II," which was the best boat hitherto sent over for the Cup, the issue of the race will depend very largely upon the handling of the competing craft. Both the British and the American skippers, for the first time in these Cup races, will be amateurs, and each is recognized as being the ablest representative of the Corinthian sailor in the respective countries.




**The tallest rig among the Cup yachts of 1920 is that of "Shamrock IV." With her water line at street level, the head of her clubtopsail would be level with the cornice of a 14-story office building. To make another comparison, it would extend 45 feet above the underside of the Brooklyn Bridge**

## Gas Laboratory of the U. S. Bureau of Mines

AMONG the many activities carried on by the United States Bureau of Mines is the work being done on gas masks for the protection of workers in various industries. So important is this work that the Bureau at its Pittsburgh station maintains a laboratory for the investigation of gases and the dissemination of information throughout the various industries concerned. The staff of this laboratory is constantly in receipt of problems relating to the protection of workers who may be exposed to gases, and valuable, practical results have been obtained as the result of research. Before the war the Bureau maintained crews trained in the use of self-contained oxygen breathing apparatus with enough oxygen compressed into metal bottles to maintain a man for half an hour. By the use of these the wearer could penetrate mines filled with deadly gases to rescue entombed miners. The experience of these men was of great assistance to the Government in developing the army type of gas mask. These masks differ from the oxygen breathing apparatus in that the masks serve only as filters for removing comparatively small amounts of noxious gases from the air.

The Bureau of Mines is now interested in adapting the gas mask to serve in the industries, where they are finding wide application.

The SCIENTIFIC AMERICAN in its issue of October 25, 1919, published an article on the gas mask in industry, which told of the numerous uses made of the mask, and in the current issue of the SCIENTIFIC AMERICAN MONTHLY for July will be found an article specially written for the SCIENTIFIC AMERICAN by S. H. Katz, Assistant Physical Chemist, Bureau of Mines, which will well repay a careful reading.

As an instance of the effectiveness of gas masks in industry, there is instanced the case of certain painters who were using an air-spray brush in painting some rather deep and narrow wooden bins. As a result of inhaling the turpentine, paint vapors, et cetera, the painters became sick and one man was for several weeks under the care of a physician. As a remedy gas masks were provided and the men worked on the job for months with no further ill effects. The Bureau is doing excellent work in testing the permeability of the material of which gas masks are made, and a schedule of tests and requirements necessary to secure the Bureau's approval has been established.

As showing the great care necessary in selecting gas mask material, Professor Katz quotes the case of the death of James S. Cunningham, foreman miner of the Bureau of Mines, who went down into a storage tank which contained seven inches of gasoline at the bottom, the air therein being charged with gasoline vapors.

He wore a half-hour oxygen breathing apparatus, but it was soon noticed that he was in distress, and in attempting to ascend the ladder he fell back into the liquid gasoline. In the subsequent investigation of the permeability to gasoline vapors of the rubberized fabric of the breathing bag, made at the industrial laboratory, it was found that the fabric was exceedingly permeable to gasoline vapors. Consequently further experiments are in process from the results of which specifications for breathing bags impermeable to gasoline and other vapors will be drawn.

# The Romance of Invention—XIV

## Cottrell—Catalyser

By C. H. Claudy

HUGGING his hard won secret to his bosom, the wild-eyed inventor, hounded by heartless capitalists, crawls to a corner of his miserable garret to die. 'Never shall they rob me of the fruits of my genius,' he breathes desperately. "They would exploit my brains for their own profit, but I will have it all, all, or no one shall have it.'"

Thus the inventor of the novel and the moving picture.

But not always thus the inventor of real life. Undoubtedly many who have been better scientists than business men have failed to realize the financial rewards their discoveries made for others; but, strange as it sounds in this dollar-chasing age, not all inventors want to make their inventions a source of personal profit.

There is Cottrell for instance—Cottrell who invented or discovered (it was a little of both) one of the fundamental processes for which patents have been granted, that of the electrical separation of solid and liquid particles from chimney smoke. "Electrical precipitation of suspended particles" is its proper name, and a very wonderful, if very simple, process it is, of which more in a moment. It is not only wonderful and simple but commercially it is extremely valuable, a process applicable to a great many different industries, and which, when used, in some cases adds the value of a by-product larger than the profits earned by the main product.

*THE reader of this series might be pardoned if he had got the idea that all inventors fall under one of two types—the inventor of fiction, who gets swindled and starved, and the inventor of fact, who gets rich and famous. But Dr. Cottrell's case shows that there is at least one example of a third type—and surely this example makes the best story of them all. There is something that intrigues the fancy in the tale of the scientist who hits on an epoch-making discovery, who commercializes it for a return of millions of dollars—and who, after making provision for his own modest wants, devotes the balance of his royalties to the advancement of human welfare through endowed research. The story of Dr. Cottrell and his Research Corporation is really one of those things that go to support the thesis that truth is stranger than fiction.*—THE EDITOR.

Here was a great chance for a man to get rich from the work of his brains. Cottrell, however, according to those who work with him and know him best, has so great a fund of optimism, and so large a love in his heart for science, for discovery and for making the products of both of service to humanity, that he preferred to devote his talents to better ends than the mere making of money.

So there was no attempt to exploit the Cottrell patents financially. Instead, he offered them to the world, to be used for the benefit of the world.

He did not make them public property, however, or do anything so inadequate as "give them to the government." Dr. Cottrell has pronounced ideas on the subject of making patents available to the general public and holds, and not without much reason, that to give them away is often to bury them, since what is free as air to all is frequently not thought of worth to any. Moreover, manufacturers hesitate to put money and time and plant into the production of an article which anyone can duplicate and anyone can sell. Finally, Dr. Cottrell doesn't believe that industry needs free gifts to keep it alive.

So he first offered his patents to the Smithsonian Institution to be administered by that body, and later, for administrative reasons, and with the cordial consent of the Smithsonian Institution, formed the Research Corporation of New York, and handed his patents over to its use. The Research Corporation is unique among institutions because its charter provides that no dividends shall be paid upon its stock and that the entire net profits are to be used for the advancement of technical and scientific information. In other words, while the Research Corporation is in business to make a modest amount of money, that money is not to be the personal profit of anyone, but is to be devoted to the advancement of science and industry. This, in brief, was Cottrell's idea of what ought to be done with his fundamental patents—that they ought to be made to work for the world, and the profits they made should also be made to minister to the world by being used to aid further discovery and invention.

Whether Dr. Cottrell will be longest remembered for his contribution to applied science, or for his formation of the Research Corporation and any gifts which it may give to the world through its investigations and through the labors of those who win its Fellowships, is not a question which can here be debated. But as the Cottrell patents were, in a sense the "working capital" of the corporation (its actual capital paid in at its foundation was $10,000 and its total capitalization as provided for in the charter, double that amount) it may here be of interest to say a word or two as to what these patents are and what the Cottrell process is, for the benefit of those whose knowledge does not extend to an understanding of one of the most beautiful applications of pure science to the industrial arts.

In many industries a useless by-product is gas of one form or another, which gas carries in it a large quantity of suspended matter. Prior to the Cottrell process, these suspended articles were carried off with the gas or smoke and lost. Many of them could not be screened out as any screen fine enough to catch them would clog up and choke, and the draft would cease. They could not be removed by such familiar processes as passing the gas through a liquid to dissolve them, in some cases because the solids were not easily soluble, in others because of the expense of such a process.

Then came Cottrell with his electrical precipitation and waste-product problems of a hundred industries were solved.

If you were to go into a well equipped laboratory and point a needle charged with a high voltage current towards a plate charged with a current of the opposite sign, you would get, at a certain distance, a distinct wind or air current—sufficient, in the familiar laboratory experiment, to blow out a candle flame. The air impulse is caused by the electrical charging of the molecules of the air so that they are repelled by the one and attracted by the other electrode. Such is the Cottrell process, which can remove from gas the solid or liquid globules which it may contain. Just as the molecules of air do not stick to the plate electrode, so will the molecules of any gas through which the current is sent, not stick to the electrode; the process removes solid or liquid matter from gas, not gas from gas. But, by a regulation of the temperature of the gas to which the current is applied, one or more processes of removal can be carried out. Solid matter can be eradicated at a certain temperature. When this is lowered it produces a liquid content to the gas, when the liquid globules can be removed. The Cottrell process, then, is not only a precipitation but a selection of what is precipitated. In practice the process operates by passing the gas or gases, containing the finely divided solid or liquid particles which are to be removed between two systems of electrodes, one of which is charged so that there is maintained a difference of potential of from 15,000 to 100,000 volts between the electrodes. This difference of electrical potential varies according to the spacing between the electrodes. The small particles of matter becoming electrified in the intense electrical field are precipitated on the electrodes, the result being that the gas comes out practically clear of solid matter, which is all retained in the apparatus, from which it is later mechanically removed.

In smelting and refining furnaces much copper, lead, silver, gold, zinc and other valuable metals is wasted in the smoke and gas from the furnaces. Applying the Cottrell process saves all such waste, to an amount which not only pays for the installation and operation of the apparatus but in many cases delivers a handsome profit besides. In other industries where the fumes given off are noxious, the Cottrell process not only recovers an otherwise wasted dividend but deprives the gases of their noxious elements. Sulfuric, nitric and hydrochloric acids are thus recovered; arsenic, lead, zinc and other poisonous material are removed and in one case at least, that of obtaining potash from cement-laden air in cement works, the recovered material competes with the main product in value.

In practice, the negative electrodes are small, such as wires or chains, and the positive electrodes are large, such as plates or pipes. The electrodes get their current usually through some high voltage transformer and rectifier, in order to obtain from ten to one hundred thousand volts of direct current. The expense of operation of the precipitating plant is but little more than the current expense plus the removal of the precipitated material.

Dr. Cottrell would be the last man in the world to claim all the credit for having set before a waiting world a successful system for removing solid or liquid particles from gas. Many inventors have worked on the same problem and many have been the investigations leading towards the ultimate truth. But none can deny to the Cottrell patents the honor which comes to any which pass the final test of working. There were telephones before Bell, flying machines before Wright, phonographs before Edison, cables before Field, and wireless before Marconi, but they were the men who "did it"; who brought the knowledge which was previously in an abstract and theoretical form, into concrete practice.

So with Cottrell; his patents *worked*, and his brains put electrical precipitation into industrial practise.

Prior to his advent into the public eye he was an instructor in Physical Chemistry at the University of California. He holds a B. S. from that institution, is Doctor of Philosophy from Leipsic University—if he writes his name and titles in full he is Frederick Gardner Cottrell, B.S., A.M., Ph.D. Later he became assistant professor at the university, but then the Bureau of Mines reached out a long arm and grabbed him, and he came—for a little while. He has been with the Bureau of Mines now since 1913, first as Consulting Chemist, then Chief of Physical Chemistry, next Chief Chemist, and is now Chief Metallurgist.

Recently he received the thirteenth Perkins Medal for his achievements, the presentation being made before the New York section of the Society of Chemical Industry. In a speech made about him at that presentation it was said: "It was a familiar phrase at the

(*Continued on page 22*)

**Frederick G. Cottrell, inventor of electric precipitation**

# What Industry Can Do for Americanization

## And Some of the Things Which the Industries May Expect from Americanization in Return

By H. T. Waller

INDUSTRY occupies a strategic position relative to the foreign-born. Industry has needed the man with the pick and shovel, the man with brawn, the man eager to make good, the man willing to work under all conditions and at all times. The industrial progress of this nation has its foundation built by the supply of immigrant labor. Industry, however, during the later years has come to recognize a much greater potential force in its unskilled labor than heretofore. It has come to recognize a terrific loss due to misunderstanding; it has realized also that only as understanding is created between employee and employer can best results be secured.

Outside of industry certain social and educational forces have been working many years to create a better understanding of the foreign-born situation. Many have recognized that only as a common language was used could the best of understanding be created and maintained, and to this end educational and social workers have been seeking to develop an Americanization consciousness that would appreciate the potential value of the immigrant. As the work progressed under private and organization leadership it soon developed that in order effectively to carry on Americanization work, in order to reach positively the great army of workers, it was necessary to have classes and activities conducted where these people were brought together in natural groups. This place is the industrial plant. Watch the thousands of employees as they come to and leave work. They come from and scatter to all points of the compass. While in the plant and even in the departments of the plant are gathered large groups of these men who here, at least, have a common point of interest. It is the place where their daily bread is earned, and where they are earning that which will enable them to safeguard and enjoy the future. It has been found also that of all influences that are effective in dealing with the foreign laborer the influence of his foreman leads. Consequently, certain workers in this field have endeavored to develop a plan by which the largest number of foreign employees might be most effectively reached for the benefit of industry, for the benefit of themselves, and for the benefit of the community. For, after all, the interests of the one are the interests of all three, and injure the best interests of one and you will injure the best interests of all three. *For the basic interests of employer, employee, and community are identical.* What then can industry, occupying as it does the strategic vantage point, do?

Industry can and should supply within its organization a person or persons charged with definite responsibility for developing the best interests of the foreign-speaking employees in the plant. No outside agency can come in and do what this agency from within can do. It is necessary that industry shall stick to its job of production and any work that is done must be so conducted as not to interfere with production, but this has a vital influence upon production, therefore, find a man or men with high purpose, social vision, and practical common sense, who will work together with the foreman, assistant foreman, and American workers of industry. The result will be an established point of contact with the foreigner that is bound to be of tremendous value. The men responsible for Americanization in the industry must be men of community vision, not men who are simply creating a department and a job for themselves. This latter point of view would be suicidal to attainment of the object desired.

For when it comes to the question of instruction of employees in the knowledge of English, the ideal is the educational leadership of the community, namely, the Board of Education; and the point of coupling the public educational forces to the industrial power is a delicate one and calls for splendid leadership on both sides. Industry can do more for the promotion of Americanization than any other single agency. In fact, industry must do more, for it is to the best interests of industry that it should be done. The type of community in which a man lives determines more than we now realize the type of production that he turns out. There is, therefore, a compelling economic force which determines industry's place in this great problem.

Today we are facing the problem of a great labor shortage due to natural causes. The fact that foreign labor is returning to Europe is a natural thing, but if industry and the community had paid special attention to establishing a sympathetic intelligent point of contact with foreign labor, the result would have been the establishing of permanent homes in this country on the part of the foreign laborer, to a very much greater degree than has been the case. Only in so far as we are able to establish this personal contact are we going to be able to stabilize labor. Industry must, therefore, take a position of leadership in the problem of Americanization, and where community educational forces do not recognize their responsibility for adult education, then industry must and can take the leadership, and furthermore must see to it that there is a change in attitude on the part of the educational leadership in such a way as to meet the needs of the community which they are serving. One emphatic warning is essential in connection with this problem. Force, compulsion, paternalism should be shunned as though they were a plague. We do not want American citizens as a result of compulsion. Friendship is not a thing that can be forced. Friendship is the result of sympathetic understanding. Friendship will result in the building of an ideal community. Understanding will result in the creation of an ideal industrial relationship. It is possible to secure this through the point of contact established in industry through the agency of Americanization leaders.

In the coöperation of industry and the Board of Education there is a combination of industry and community that is bound to react most favorably upon the individual, the industry, and the community.

Industry holds the vantage point of economic leadership. The solving of this great national problem will depend very largely upon the vision of industrial leaders who recognize the tremendous value of an intelligent understanding.

Industry must then supply leadership, money, and coöperation in the work of Americanization. The leaders of Americanization also must take their position with the leaders of direct production, working with them in close coöperation in order that there may be developed an industrial life based upon sympathetic understanding and mutual helpfulness.—*Address before the National Safety Council.*

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### Home-Made Refrigeration

To the Editor of the SCIENTIFIC AMERICAN:

May I have leave to remark the article in your May 15th inst. issue entitled "To Offset the High Cost of Ice," by W. Lambert, and say:

The method explained and illustrated is not new in the field of ice manufacture and mechanical refrigeration and if "the system has been perfected" I would be surprised but also pleased to be convinced of it.

"Perfected" is a strong term.

I take it to mean that the device has been made safe to operate and that it would be operated with commercial profit.

In close observation over thirty years in the fields of ice-making and refrigeration, I hardly think I exaggerate in saying I have known of nearly a hundred concerns that have undertaken the manufacture, sale and installation of machines of this type, none of which survived on account of financial failure.

Further, a number of such machines have exploded, causing loss of several lives and serious destruction of property because someone failed to open a valve that should have been opened before getting up pressure.

Installation of such refrigerating plants should be prohibited unless fitted with safety devices that would render them dependably proof against explosion regardless of the dependability of anyone who might be responsible for their safe operation.

It sounds plausible and has been luring bait for financial "suckers" heretofore, but would-be capital stock investors and contemplating purchasers of such plants would well be warned to heed the record of experience before parting with their good money.

A. C. JACKSON.

St. Louis, Mo.

### Accidents That Happen and Others That Don't

To the Editor of the SCIENTIFIC AMERICAN:

I have been much interested in noting the fact that you are occasionally publishing articles having to do with industrial relations and accident prevention. The article in the April 10th issue, "How Much Is a Worker Worth?" is particularly interesting, but there are a few points in this article that from the standpoint of practical accident prevention I believe should be cleared up.

Excellent as the article is, in these cases it reads either as though the author accepted some hearsay evidence without investigation, or else made his statements without due consideration, and therefore failed to convey the impression he desired. If upon comparing my comments herewith with the article you feel that they are justified and will be of value to your readers, please publish this.

In the third paragraph of the above article the author states that there is scarcely a public school in the United States today that is not absolutely safe for our children. I feel very safe in saying that this article, if called to the attention of any fire prevention engineer of broad experience, would be characterized as being grossly untrue. An illuminating discussion of this subject appears in the July, 1919, issue of the *National Fire Protection Association Quarterly* under the title of "Fire Protection for Schools." It is particularly important that the reader of so reliable a publication as SCIENTIFIC AMERICAN should not be thus misled, because the main obstacle to securing fire safety in school buildings is the lack of knowledge on the part of the public. It is hard enough to overcome ignorance without having to combat misinformation from journals of standing.

I strongly suspect that the discussion of electrical hazards is not based upon sufficiently sound information or long enough experience. Accidents caused by electricity will vary widely, according to the nature of the industry and the use and control of electricity. With standard equipment, and a reasonable standard of safeguarding, accidents caused by electricity will not only be few, but they should cause little time loss or compensation costs, except, of course, in the case of the electrical industry itself. Even here, such accidents can usually be kept down to a small proportion of the total, both in number and loss occasioned.

The incident cited, in which an employee attempted to light his cigarette from an arc drawn by opening a switch under load, if true as stated, shows sub-standard equipment, because the ordinary type of open knife switch should never be used on such voltages as 16,000. Disconnecting switches should be used and they should be so mounted and arranged as to be opened by a long pole.

The reference to some one working on the line and throwing an extra heavy load on the circuit is obviously an error.

Later in the article, the author tells of an accident occurring from an arc caused by the opening, under load, of a disconnecting switch of a 23,000 volt circuit. I do not understand the explanation, because it is stated that the operator "tripped the switch," which, of course, means that he opened the oil switch, killing the circuit. In other words, he either must have opened the disconnecting switch on some other circuit, or else the oil switch failed to work and did not break the circuit as he supposed. In any case, had the disconnecting switches been properly arranged and separated, with proper marking, the accident could scarcely have occurred. The speed with which he opened the disconnecting switch would have no bearing on the matter.

R. P. BLAKE.

Philadelphia.

# Wonders in Steel Forging

## The Rôle of Giant Hydraulic Presses and Huge Steam Hammers in Large-Scale Blacksmithing

By A. R. Surface

THE engravings show some very remarkable instances of steel forgings made in France. For the cruisers "Virgniaud," "Danton" and "Voltaire" thirty shells were forged for the turbines, while a number of similar shells went into the steamer "France." An idea of the sizes may be gathered by comparing with the standing men. Among the shells forged for the latter vessel, were one or more plain cylinders having an outside diameter of 10.824 feet and an inside diameter of 10.168. This means a wall thickness of about 3.9 inches. The shell length was nearly 11 feet. The weight of a big fellow like this is 54,800 pounds. While the shell is quite plain, the great length and diameter presented features of difficulty in forging. Another form of shell is one having the same internal diameter all the way through, but a decided variation in the outside diameter. Examples of this are to be seen in Fig. 1. One or more shells of this type were forged for the "France," in which the larger outside diameter is quite equal to the external diameter of the former forging, viz., 10.824 feet. The internal diameter was made 6.855 feet, corresponding to which is a wall thickness of 1.985 feet. This is a very heavy wall indeed. This thickness was maintained for about 2.3 feet of the total length of about 5.3 feet. The thin part of the shell was made nearly 5 inches thick. We have a very remarkable example of the wonderful forgings being turned out in France. This piece weighed 88,000 pounds—quite a chunk of metal.

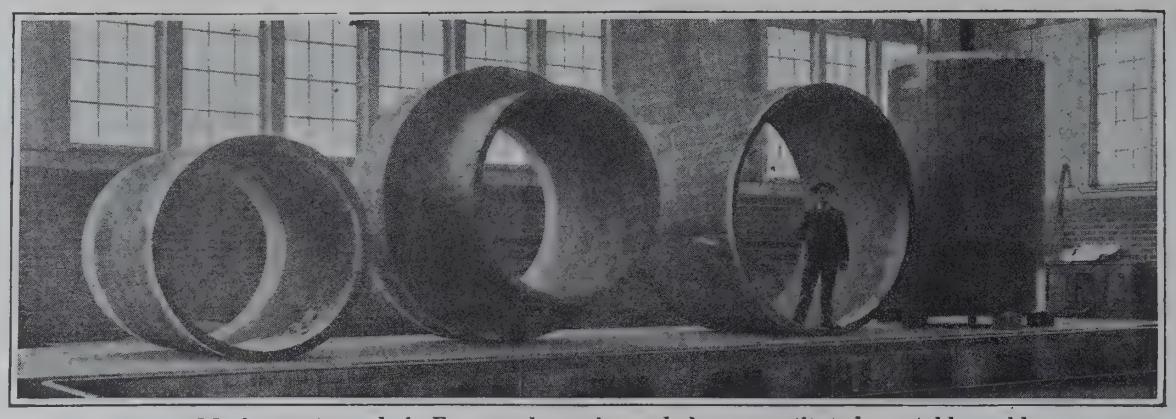


**Fig. 1. Marine parts made in France whose size and shape constituted a notable problem in forging technique**

Perhaps more remarkable yet are certain rings forged by the same concern. The metal was a special nickel-chrome steel. The rings were of considerable diameter relative to the length. The outside diameter was nearly 11¼ feet, the thickness of metal about 5.2 inches, and the length of the ring only 17.71 inches. The work began with a heavy-walled ring of much smaller size, but whose length was just the same. There were six heats in all. The great difficulty in producing the final result centers on the maintenance of perpendicularity to the axis. All the examples illustrated and described so far were forged in the hydraulic press. To these examples may also be added the great shaft for a cruiser shown in Fig. 2. The advantages claimed for the hydraulic press are: Absence of vibration, superior mechanical result, and rapidity and precision in forging. Further, this means of heavy forging lends itself to the forming of the work on a mandrel. Tubular pieces may with advantage be handled by the press. However, the great French works at which the foregoing forgings were produced has not entirely abandoned the percussion idea. They still have three rather good sized hammers of 100, 30 and 20 tons capacity, respectively, besides a large number of smaller units. At last accounts, the works contained, however, eight hydraulic presses whose capacities range from 600 to 8,000 tons.

However, France is not the only country by any means where big presses have come into use. Just prior to the outbreak of the Great War a giant forging press was built for one of our great plants where railroad equipment is manufactured. This press has the capability of developing a pressure of 9,000 tons from its main cylinder. It was built to forge car wheels from hot blanks of steel at the rate of 40 per hour. It has, however, turned them out at a speed of one per minute. The total stroke of the apparatus is 32 inches. Naturally, it is only in the latter part of the stroke when the full power will be required. During the earlier part of the stroke, operation is secured by a water pressure of merely

**Fig. 3. A double-acting steam forging hammer of American manufacture**

30 or 40 pounds per square inch. After this, a pressure of 2,500 pounds per square inch may be used all along the stroke. Finally, during the last four inches, this pressure may be doubled. As the big cylinder has a diameter of 72 inches, a machine of such power is a heavy affair. In the present case, the cap is a nickel steel casting weighing 375,000 pounds. The plunger is also of nickel steel. To its bottom is attached the cross-head, a big steel casting weighing 250,000 pounds. This cross-head casting is thought to be a remarkable example of the founder's art, as in the machining no defect was found. The base is also of cast steel.

The pressure of the press is exerted against the Torsional resistance of four big columns. These are themselves hollow steel forgings, 30 inches in diameter and 33 feet 5 inches long. The compression operation is carried out as follows. The cylinder carried by the cap goes under pressure by the forcing of water into it. This pressure reacts on the plunger and forces it downward. The cross-head with the forming die in place is thus pushed down by the plunger and pressure exerted on the work lying on top of the base. When this pressure comes on, the four cylinders have to resist it. The transportation of this great piece of apparatus across nearly the full length of Pennsylvania involved special problems, and led to the use of a special car with two trucks, one at each end and each containing 16 wheels. There was a connecting bridge frame for the load, consisting of two parallel girders of considerable size.

Another great forging tool was built in the United States, being shipped to the point of use at or near Washington soon after America went into the war. It is not a hydraulic affair. It is a modern machine, however, which is correctly described as a double-acting steam forging hammer (see Fig. 3). At the time it was claimed as the biggest hammer of its type ever produced in the United States. It was shipped to its destination in 14 railway cars. There is a 96-inch stroke and the cylinder has a bore of 40 inches. The ram or hammer is 51 inches wide, 72 inches high, and 66 inches deep, front to back. This ram is notched to provide for the handling of a steel die 72 inches front to back, 41 inches wide and 28 inches high. This itself is quite a piece of metal and is said to weigh 10 tons. The combined weight of falling parts is about 80,000 pounds. A steam pressure ranging from 100 to 150 pounds per square inch was in contemplation. When operating under full steam pressure, the blow delivered is said to amount to 8,000 tons. The anvil, steel anvil cap and steel die together weigh 350 tons.

The standard type of hydraulic press has four tension columns. These hold cap and base apart and resist their further separation when the pressure is on. Ordinarily, such presses have their columns in a vertical position. But this is not essential. Some years ago a Philadelphia concern built a 2,000-ton extrusion press which had its columns horizontal. A notable thing about this press is that the pressure chamber is heated to avoid chilling the metal too much when it goes into position for the extruding operation. The metal has at this time a temperature of 1,650-1,800 degrees Fahrenheit. If the pressure chamber where the metal is put should be cold, the chill would affect the surface of the metal at once. There would thus be both hard and soft metal in the same mass which would doubtless give rise to irregularities in the extrusion. In order that the pressure chamber itself shall withstand the heat and in addition not lose too much tensile strength, a special steel is used for its walls.

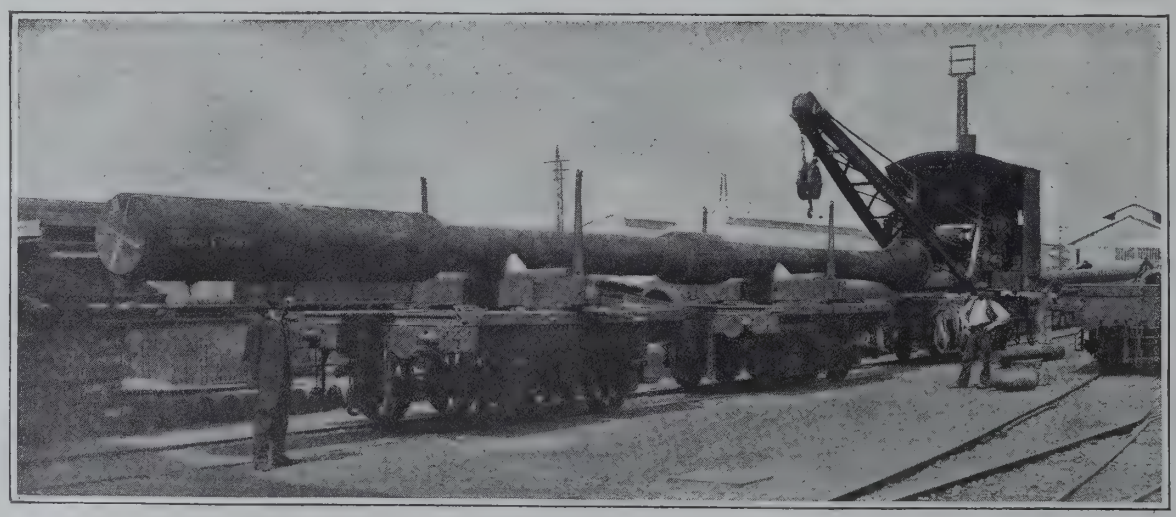


**Fig. 2. Shaft for one of the big French cruisers, produced in one piece by aid of the hydraulic press**

## Bunk Cars That Satisfy Labor

THE ever-growing scarcity of labor has resulted in a demand for better working and living conditions that is not to be denied. Indeed, from time to time these columns have illustrated and told about the model camps and living accommodations now being used by contractors, lumber companies, manufacturers and others in taking care of their labor and trying to make it as permanent as it can be made.

In the accompanying illustration we have another interesting case of the excellent living conditions which prevail in almost every walk of modern industry. In this case it is one of the bunk cars of a western lumber company. A large number of these cars go to make up a long train—a veritable village, to be sure—which moves from place to place as the army of lumbermen is shifted through the great lumber region of the Pacific Northwest. Each car contains comfortable beds, abundant light, and excellent ventilation facilities. This type of bunk car is a worthy improvement over the old bunk car which was no more than a regulation box car fitted up with crude bunks and having one or two side windows for ventilation. Each new car accommodates 28 workmen in comfort.—By *C. L. Austin.*

**This bunk car, which is a unit of a long train, accommodates 28 lumbermen in the utmost comfort**

## Still Another Method of Sawing Big Trees

IT seems that there is no end to the methods developed for simplifying and easing the work of sawing big trees. Within the past few months these columns have had numerous ingenious ideas along these lines, some from abroad and many from Americans, some calling for gasoline power and others using good old man power.

Now it is L. H. Porter of Oregon who has improvised an ingenious arrangement which is shown in the accompanying illustration. Mr. Porter makes use of a hinged upright with cross handle-bar which, when worked back and forth by the operator, transmits the power to a large cross-cut saw through gearing and levers. In this manner it is claimed that the biggest logs can be cut up by one man without undue effort.—By *Alfred Langville.*

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**Rocking the handle back and forth causes the big cross-cut saw to go through the log in quick time**

## Speeding Up Reforestation with the Planting Board

ALTHOUGH planting seedling trees by hand is laborious and expensive, annually the Federal Forest Service has to reforest between 10,000 and 12,000 acres of land denuded by fire of tree resources. Forest Service employees as well as natives in the various national forest regions gather the cones from the trees before the seeds drop out, often collecting large caches of cones stored away by the pine squirrels who have hidden the tree fruit away for winter use. Subsequently at the various forest stations, the cones are heated in warm rooms so that ultimately they open and yield up the seed concealed within them.

After being cleaned and graded the seed is planted in nursery beds. When the seedlings are well developed they are dug up and transplanted. To minimize the labor involved in setting the individual seedlings by hand, a planting board is used which is threaded with the seedlings and then placed on the prepared seedbed so that one entire row of baby trees is imbedded in the soil in a single operation. Sometimes when the infant trees are a little larger they are again transplanted, the purpose being to develop plenty of stocky growth and hardiness during the first two or three years of the seedlings' lives so that when set out in the forest proper they will survive and develop into stout, sturdy trees. —By *G. H. Dacy.*

**This planting board enables the foresters to set out a row of seedlings in a single operation**

**How the Bureau of Standards tests out a new design of airplane wing by means of weights and gages**

## A Moonlight Rainbow

NEARLY every one has seen one or many rainbows. But how many have seen a rainbow at night? Yet it is, of course, quite possible for the rays of the moon, reflected from a rainstorm, to form a rainbow in exactly the same manner as the sun's reflected rays form the ordinary rainbow.

The writer, while a passenger on the U. S. Army Transport "Kilpatrick," bound from San Juan, Porto Rico, to New Orleans, La., witnessed, at 8:30 P. M., on October 10, 1919, in latitude 20° 30′ N., longitude 72° W. (just north of Cape Haitien, Haiti) a large and distinct rainbow, due entirely to the rays of the moon. The rainbow, which was west of and in front of the ship, was complete, toching the water at both ends.

The fact that the ship was headed directly into the center of the rainbow and of the storm upon which it was reflected added a portentousness to the already weird and beautiful effect. The rainbow continued to precede the ship for about thirty minutes, and was taken by the superstitious on board as a favorable omen, especially as the ship was at that time in the same waters in which several ships, including the ill-fated "Valbanero" met disaster in the severe storm of a month previous.—By *Lieut C. C. Harshman, U. S. A.*

## Something New in the Way of Airplane Metal Ribs

EXTREME altitudes—the objective of Major R. W. Schroeder and aviators of like ambitions—are not to overshadow another problem of aeronautics, that of multiplying the speed range of airplanes. A new type of airplane rib developed by the U. S. Bureau of Standards, by varying the angle of attack, is capable of making greater speed than hitherto possible with the prevailing wings.

Described as the Parker variable-camber wing, the newly-designed equipment recognizes the principle of construction that if the angle of attack can be efficiently varied from a very small to a very large angle, a wide range of speeds is possible. The properties of the type of wing usually seen are held responsible for the restricted speed of airplanes.

Among the features of the rib structure of the Parker variable-camber wing are: Deformation regularly with the load up to the unit flying load, then remains rigid under further applications of weight, being strong enough to stand up under several times its normal load without failure. Simple, foolproof and easily manufactured are the virtues claimed for the wing. Metal construction is necessary in the new type of rib; other portions of the machine such as spars, bracing wires, and struts are not altered. The essential parts of the new wing are: channel-shaped strips forming upper and lower surfaces of the rib between the spars; compression links are of channel section also and fixed to outer channels by pins, allowing necessary angular motion between links and strips; the tension links are flat strips of steel attached to the same pins which carry the compression links.

A radical departure from the prevailing type of wings, these links in streamline position carry no load, but in a lifting attitude they straighten out and make a truss of the rib, thus preventing further deformation under loads. The links in the first two and last two panels are slotted to permit of the insertion of reserve links. A tail piece is fixed in shape, riveted to the upper strip and constructed to slide over the rear spar. A spring is placed between the rear spar and the tail piece, this spring being used as a tension attachment to the rear spar and the front compression member of the tail piece.—By *S. R. Winters.*

*Left:* View of entire dam from downstream, with central sections tilted. *Center:* A close-up of the super-dam, showing the tilting sections. *Right:* Water flowing over the dam via the first six of the tilting sections

**The elastic dam, crowned with metal sections that tilt successively as the backwater behind the dam approaches the danger point**

# Baltimore's Tilting Dam

## A Structure That Opens Automatically When It Has Backed Up Too Much Water

By J. F. Springer

THE construction of a dam is not always a case of simply building a structure competent to resist the maximum efforts of the body of water at its back. The engineer may be called upon to do more than that. A possible case in point is the tilting dam at Lock Raven a few miles northeast of the City of Baltimore. The water department of the city desired to increase the capacity of the reservoir-lake Lock Raven in order to meet the needs of the population. It was proposed some years ago to erect a dam with a fixed crest 188 feet above average mean tide and a movable crest 4 feet higher.

All this is simple enough; there are various means of increasing the height of a dam temporarily. However, further upstream was located a big manufacturing concern which used for power purposes more or less of the water before it reached Lock Raven. The elevation of the tail race at the manufacturing plant was 196 feet above average mean tide. With a dam a few miles downstream impounding water back of a crest at elevation 192, the manufacturing concern foresaw possible interference with the effective head of water used by it. The total margin between the two levels was only 4 feet, which would be diminished by the depth of water over the crest. Upon going to court, the manufacturing concern lost. At the same time, the City of Baltimore made a concession to the extent of putting upon the masonry dam, with a crest at elevation 188, a super-dam which goes into and out of action automatically to prevent an excessive rise of water above its own 4 feet of height. That is to say, along the crest of the masonry structure twenty-seven separate and distinct tilting dams have been constructed. With these twenty-seven dams standing in normal position the Lock Raven Dam has its crest at elevation 192. If the water rises 1.5 feet higher, six of the twenty-seven units automatically tilt, the result being a lowering of the crest through this region. If this does not relieve the situation and the water level over the dam continues to rise, then when the level gets to elevation 194—that is, two feet above the maximum crest—nine more units automatically tilt. If notwithstanding this opening up of passage-way, the water goes on up six inches higher—that is, to elevation 194.5—then four more units tilt. Similarly, four units tilt at elevation 195 and four at elevation 195.5. All twenty-seven have by this time gone into tilted position and are assisting to pass the water along. It will be seen that very elaborate provisions have been made to protect the manufacturing plant and perhaps other interests upstream.

Up to some seven years ago Baltimore impounded a part of the waters of the valley of the Gunpowder River by a stone dam 25 feet high. This dam created a small reservoir which was called Lock Raven. Its capacity was only about 510,000,000 gallons at best. Because of the continued deposition of silt, the capacity fell off more and more. In 1900 it had dropped to about one-third of the original. However, by dredging, the reservoir was kept in commission. The new dam is located something less than half a mile farther upstream than the old one. With its crest at elevation 192, the new structure makes of Lock Raven a lake of 620 acres with a storage capacity in the neighborhood of 2,000,000,000 gallons. This is estimated as sufficient storage, if both clear and turbid water are used, to guarantee a daily supply to the city of 90,000,000 gallons.

However, the authorities are looking ahead, and have constructed the base of the present new dam of such width as to permit an increase of its effective height to elevation 305.0. This is 113 feet above the crest of the new super-dam. The lake back of the dam would then be increased to an area of about 9,500 acres with the capacity of 142,300,000,000 gallons.

The general principle of action of the tilting dams may be understood with the aid of the sectional diagrammatic view shown in Fig. 1. The masonry dam

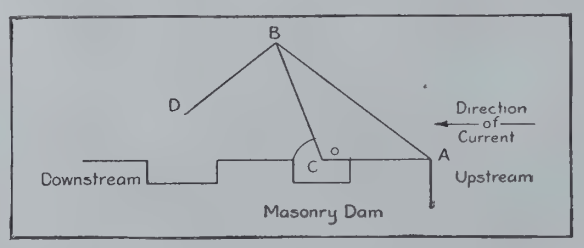



**Fig. 1. How the tilting sections stand when in the closed position, the pressure against the face AB not being sufficient to rock it over**

is surmounted by a structure which is, in section, of a triangular shape. This is pivoted at C. The upstream face is at AB, which presents an inclined surface at about 40 degrees to the horizontal. Under ordinary circumstances, the center of gravity, not shown in the figure but to which we may refer as E, lies upstream from a vertical line drawn through the hinge. Consequently, the tilting dam will of its own weight rest quietly upon the crest of the masonry structure. As the water rises above the level of the point A, its weight at first will be exerted solely in the direction of pinning the movable dam down upon the masonry crest. But after a time, the water will lend no aid to this pinning-down action. The thrust of the water

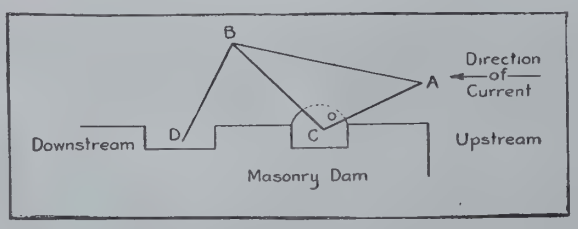



**Fig. 2. As soon as the water behind the section reaches the head for which the section is set, it tilts until the bar D grounds on the top of the masonry**

due to its weight may be viewed as a pressure exerted over the surface AB and perpendicularly to it. We will now, for the moment, take no account of the triangle's own weight. Looking at the matter thus, the triangle ABC becomes a kind of see-saw supported at C. At first, all the pressure exerted by the water is applied between A and E. But as more water comes into action, there is pressure beyond E, between E and B. This will operate against the pressure between A and E. After a time, as the water rises, there will be as much perpendicular pressure on AB above E as below it. There will be no overturn as yet. The pressures are evenly balanced, and the one below E is assisted by the weight of the super-dam. But, as the water goes on up, a time will at last come, if the triangle projects upward far enough, when the perpendicular pressure on AB above E will just equal the same pressure below E. The movable dam is now about to tilt. It is possible so to adapt the form of the triangle and so to distribute the weight of the structure that the dam will tilt at a predetermined level of the water. That is just what the designer, Mr. V. Bernard Siems, Pitometer Engineer, Baltimore City Water Department, has done. Beginning with a type adapted to tilt at 5.5 feet above the masonry crest, he has added others adapted to tilt at 6-inch intervals above that level until a tilting point 2 feet farther up has been reached. In fact, he developed two groups to tilt at the second tilting level.

One must emphasize the point that the tilting takes place automatically. The several classes of dams go into action of themselves without any attention from watchmen, operators or the like. It is the weight of the water and dam and the shape and arrangement of the parts that control. The weight of the water is the only one of these that varies. And it is precisely its variation, expressed as level, that it is desired to control. Probably, the velocity of the flow may have some effect, and also the presence of driftwood. But, disregarding such things, the dam seems a reliable structure which will act as desired when the conditions require it.

In the case of the super-dam a typical unit weighs 1,212 pounds. It is constructed in part of wood and in part of metal. Water-logging may, it is estimated, cause the weight to rise to 1,400 pounds. On this particular type of unit, the center of gravity lies 8½ inches upstream from the hinge and 1 foot 7 1/16 inches above the masonry crest. If we reduce the 8½ inches to feet and multiply the result by 1,212 pounds, we shall get 859 foot-pounds for the moment which the water will have to overcome before tilting will take place.

When the tilting does take place the movable structure turns on C and the foot D coming into contact with the top of the masonry dam, or perhaps the bottom of a depression in its crest, halts the movement. Water can then flow over and through the structure to the downstream side of the general dam.

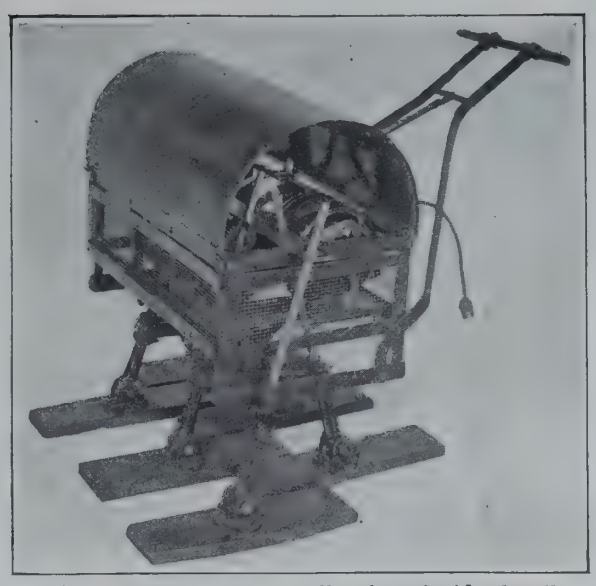
Since the dam has been finished, there have been high water conditions. Types adapted to tilt at the first two levels have actually done their tilting. In many cases where actual tilting has occurred, the tilt has taken place somewhat earlier than the design contemplated. Thus, the tilting has occurred when the water was still 4 inches short of the proper level; in other cases, the action has taken place as early as 7 inches ahead of the level. In explanation of this, Mr. Siems says in effect that as the water goes down and gets near the level of the masonry crest, foreign matter lodges at the toe of the super-dam, so that when it drops back to normal position, it seats itself on this accumulation and rests in a position forward of normal. Similarly, the warping of timbers in the super-dam will have the same effect. Under both conditions the super-dam is in a position where the head necessary for tilting is decreased. On the other hand,

*(Continued on page 22)*

### A Silage Tamper That Walks as It Works

IN order to convert fodder into silage, certain necessary chemical changes must take place in the silo. Investigation has proved that such changes cannot take place to the proper degree if the air contained in the loose fodder is not expelled at the time the silo is filled. And so a very necessary operation in the filling of a silo is to tamp down the fodder to expel the pockets of air, and it has remained for an American inventor to develop a machine that tamps the fodder by walking and stamping on it.

The walking tamper appears in the accompanying illustration. When this machine is placed in the silo, the hood, handles and feet are removed. The frame then stands 19 inches high, 25 inches long, and 14 inches wide, so that it will pass through any opening 20 by 16 inches. The tamper is operated by a one-third horse-power electric motor which drives the tamping mechanism. The machine is supplied with six feet, of which three are advanced at the same time when taking a step. This gives it a stability that could not otherwise be obtained, according to the inventor. Two of these feet measure 4 by 15 inches, while the four others measure 4½ by 15 inches. One of the outer feet has a slight curve on its outward edge, so that it can work close up to the inner wall of the silo. By means of a simple yet ingenious clutch, the feet are dropped as soon as the crank passes beyond the center, thus giving the feet a stamp that can be compared to a man stamping as he walks. The compressive force thus exerted is many times greater than if the machine simply walked as a man does. The speed can be adjusted to suit the conditions, but the normal adjustment calls for 21-inch steps thirty times in a minute. It is figured that the area of a 12-foot silo can be covered four times in five minutes.



**This mechanical tamper walks about inside the silo and tamps down fodder**

### A Load of Automobiles

WE have all read how automobile and truck manufacturers, driven to distraction by the repeated and lengthy rail tie-ups which prevented them from making deliveries, resorted in many instances to the expedient of delivering their machines under their own power. In some cases cars and trucks that were badly wanted at their destinations have been driven hundreds of miles in this way. But as the distance between the factory and the prospective user increases, this method of making delivery becomes more and more a desperate remedy, and calls for a substitute. The photograph herewith, taken on the Ohio River at Cincinnati, shows that where there exists a navigable stream such a substitute is not lacking—though in fact it may not always be an actual substitute, but rather an aid to the more tedious process of road-delivery.

The cars shown on this huge tow were made in Detroit, and were all consigned to Cincinnati and points within reasonably short distances thereof. Just what route was followed in their delivery we are not definitely informed, though we understand that they were shipped from Detroit under their own power to points on the Miami or Wabash Rivers where they could be loaded on barges for towing to Cincinnati, whence they were finally distributed under their own power. It is evident from the width of the tows that the canals connecting these rivers with Lake Erie were not utilized. A lake haul to Ashtabula or some nearby point, followed by a drive to Pittsburgh and floating thence down the river, would have been another alternative. Whatever the route taken by this first impressive cargo, however, the undertaking was so successful that it is planned to follow the same procedure to deliver a quantity of cars that have been ordered for the Memphis, Vicksburg and New Orleans districts. It seems fairly obvious that when we begin to get river transportation in such large blocks and for distances approximating a thousand miles, we have a method of delivery that may be expected to hold its own even after the railroads get back to a normal basis of operation. Lower freight bills, cheaper and easier packing, and a good many other factors seem in favor of shipping automobiles in this fashion—when the water route exists.

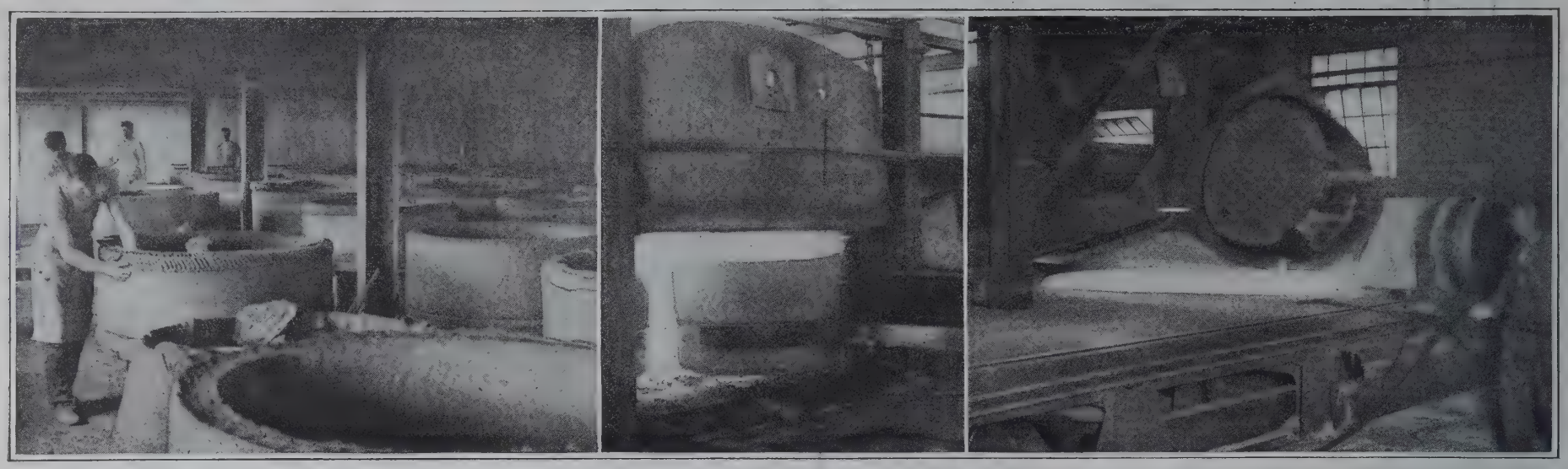
**A huge tow of automobiles shipped in this fashion in the absence of rail accommodations**

### Aiming a Mirror to Film Moving Objects

BY aiming a mirror in conjunction with the lens, instead of the entire camera, as is usually the practise, a French cinematographer, M. George E. Labrely, has succeeded in making motion pictures of rapidly moving objects. Heretofore the motion picture camera generally used has not been adapted to the filming of rapidly moving objects, such as a bird in flight and a rabbit on the run. In the Akeley camera, which has been described in these pages, the entire camera with its lens can be readily and quickly traversed and tilted to follow moving objects. In this respect, and in several others, the Akeley camera has been quite unique. But M. Labrely has introduced a new idea which promises to contribute much to the screen in the way of subjects heretofore held to be impossible for the cinematographer with the usual camera equipment.

It will be noted in the illustrations of the new camera arrangement that M. Labrely moves a mirror while the camera remains fixed. In this manner he has only a small weight to shift, and the movements can be many times more rapid than if the entire camera had to be shifted. The arrangement comprises a flat mirror held at 45 deg. angle in front of the lens, and supported by a long handle, the mirror reflecting the image into the long-focus lens connected with the camera by means of a long flexible bellows. The flat mirror can be aimed in any desired direction, and the image is reflected into the lens which remains stationary. The long handle also carries a simple direct-view finder so that the mirror can be aimed at any desired object. The Pathé type camera used in this case has hardly been modified to take care of the new arrangement, except for the drop board.

**Two views of the ingenious arrangement for taking motion pictures of rapidly moving objects, and two strips of film made in this manner**



*Left:* Preparing clay pots for fusing the glass-making materials. *Center:* Removing the pot of molten glass from the furnace. *Right:* Pouring from the pot on to the molding table for rolling into plate glass.

**Three important stages in the manufacture of plate glass**

# How Plate Glass Is Made

## The Tedious Process by Which Modern Technology Has Been Able to Make Glass without Blowing

### By Ralph Howard

GLASS blowing is one of the oldest industries in the world; it has been a feature of the industry of practically every country of importance from the dawn of history. It is, therefore, not to be wondered at that when preparation of glass in flat sheets for windows and mirrors was first undertaken, the methods followed were the same as those which had been familiar for so many centuries. The apparent absurdity of preparing first in the form of blown bubbles and then in the form of cylindrical sheets, glass which was desired in flat form and which had to be rolled out flat at considerable trouble and risk, was no absurdity at all if we look at it historically. And if we consider that even today sheet glass can be made in this way of reasonably good quality and at lower cost than by any other method, we see a vindication of those who have stuck to the glass-blower.

But the plate-glass industry of today demonstrates that it is not true, as so often carelessly asserted, that glass cannot be produced without blowing. It is more expensive to produce it without blowing, but it can be done, it is done, and a better product is thereby secured. The methods of plate-glass manufacture, however, are not nearly so well known as the older technique which was represented on a cover of the SCIENTIFIC AMERICAN within the past six months.

Plate glass was first made in France in 1688; the first glass rolled without blowing in the United States dates back to 1860 only, and was an unqualified success for the first time at an even later date. So plate glass is really a modern product.

The chief ingredients for plate glass are silica (white sand), soda (soda-ash), lime (limestone), arsenic and charcoal. The chief tool is the clay pot, and this occupies such a position of dominance in the industry that it must be given separate attention in any story of how plate glass is made.

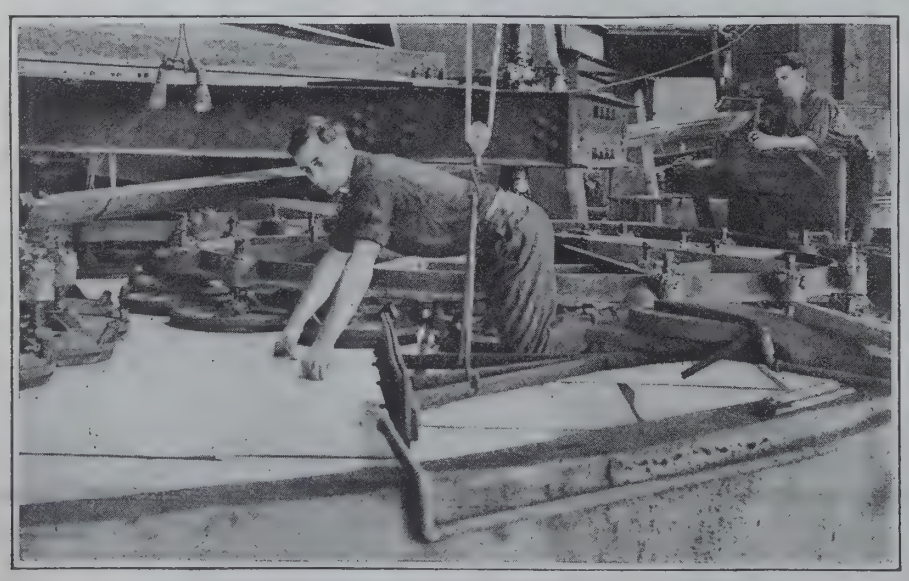
Clays of the various qualities required are mined and exposed to the elements for a time to bring about the first stages of disintegration. At the proper moment finely sifted clays are mixed with coarser, burned grades and water. In this manner the chances of shrinking and cracking are reduced. The mixture is kneaded in a mill, kept sometimes as long as a year in storage bins to ripen, and finally is passed through the laborious process of treading. And if primitive methods have been eliminated in the supplanting of the human glass-blower by the mechanical glass-roller, they have triumphed in the manufacture of the pots. No machinery has been invented by which the same satisfactory plasticity can be given the clay as by the tread of the bare human foot. The clay must be tediously treaded and treaded, many times over; without all this care, when the molten glass goes into the pot some of the ingredients of the latter would be fused out, and the entire effort involved in making both the pot and the glass would go for nothing.

The pots hold something like a ton of molten glass, at a temperature of some 3,000 degrees Fahrenheit; so their chemical and physical perfection must be very high. After they have been molded, they must be properly dried out, another operation to which the greatest care and attention has to be given. No pot may be used until it has seasoned for three months at the very least, and in many cases a year is desirable. And after all this lengthy preparation, the pot is expected to give but 25 days of service; so the glass works is kept pretty busy making pots.

When the pot has been carefully brought to the proper temperature in the oven, it is filled with its charge of raw materials. The process of melting so reduces the bulk of this charge that the pot must be filled three times before it contains a sufficient amount of "metal," as the glass men call this mixture. When the proper molten stage is reached the pot is lifted out of the furnace by a crane. A careful skimming removes the surface impurities, and the pot then is swung overhead to the casting table. The side of this table is lined with adjustable strips, which may be made as high as desired, or as low, to

*(Continued on page 24)*

*GLASS making, one of the oldest of industries, has undergone a startling extension of late years. Not so long ago it would have been easy enough to catalog all the types of glass which were produced. But today there are the familiar blown glasses for windows and other ordinary purposes. There is plate glass, a relatively modern development which does not call for the services of the blower. There are wire glasses that resist shattering to an unbelievable extent. There are figured glasses that let in light but exclude vision. And there are other tricks of the glass-maker's trade too numerous to mention. But perhaps of greatest interest is the apparently simple but really most complex process by which glass is rolled directly into sheets, without the blowing that for so many centuries was considered essential. This is the story of plate glass.*—THE EDITOR.



**The polishing process, using felt buffers and rouge**

**Removing the plate of glass from the plaster bed after the polishing**

Protection for the passer-by from flying fragments of the pavement that is being broken up

## Protection from the Ditch-Diggers' Barrage

A HANDY device shown in the accompanying photograph shields pedestrians and windows from being struck by flying pieces of stone that result from breaking through the cement sidewalk or the concrete roadway for the purpose of installing lighting conduits, repairing water connections, etc. It consists of a canvas supported by four pieces of pipe, the uprights being kept from tipping over by heavy circular metal bases. The canvas completely encircles the section of the roadway on which operations are being conducted, and insures that the inevitable bombardment of flying fragments shall endanger no innocent bystanders. The canvas can be removed from the piping and the latter quickly taken down and bundled up for transportation to a fresh scene of activity.—By *A. R. Surface.*

## A Keyboard for the Violin Novice

THE beginner with the violin has difficulty learning to finger the instrument properly to strike the desired notes. This would be all very well if, like the struggles of the novice in algebra or with the bicycle, the learner's infelicities affected nobody but the learner. With the violin, however, this is not the case, inasmuch as everybody within earshot must perforce listen to the raucous results of the student's mishandling of the instrument. To eliminate this nuisance, a device has recently been invented to aid the pupil as well as his neighbors during the trying period when the notes are struck upon the unidigital search system. The invention in question is really a keyboard for the violin. In consists of a curved board which is fastened over the neck of the violin, covering the finger board. On this are cut twelve notches over each of the four strings, and through these are passed aluminum studs which, when pressed by the fingers, lightly depress the string below and give the required tone.

In this way the student may learn the fingering of the violin exactly; and after this has been acquired the keyboard can be discarded and the fingering done directly on the finger board. If necessary, it would be possible to write the names of the keys on the studs for very small children. The keyboard does not in any way interfere with the strings, and it may be removed at any time. The inventors have tried out the device with a number of beginning students, and believe that its use will save at least six months of training.—By *A. H. Kolbe.*

## Powdered Fruit Juice

ONE of the newest fruit products is powdered lemon juice. It is pure juice reduced to a perfectly soluble powder. Details of the process used have not been given out, but it is an adaptation of the well-known spray method of reducing milk to powdered form; indeed, the originaters of the product are powdered milk manufacturers, the largest in the world. The process can also be used successfully with orange juice. The originators intend to erect a California factory for the manufacture of the product.

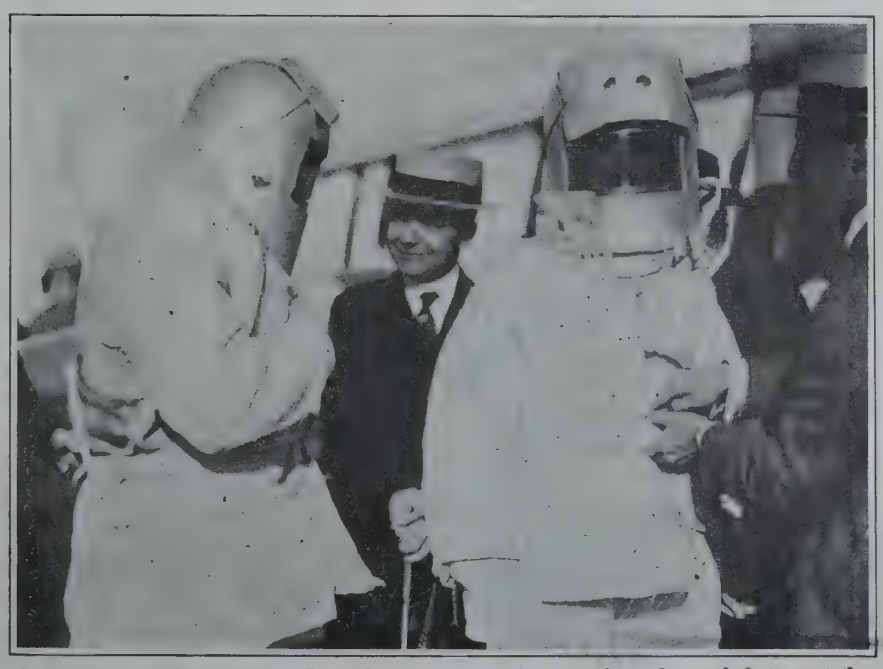
## Quality of Water and the Setting of Cement

INVESTIGATIONS made with the object of throwing light upon variations in the setting time of Portland cement have recently shown that divergencies of the kind may certainly be attributed in part, if not entirely, to the quality of the water used in gaging, says a British writer.

For the purposes of the investigation four samples of cement were employed, three of which had been aerated for 14, 24 and 48 hours before use, and the cement was gaged with 10 different qualities of water and weak alkaline solutions. From the results given by these samples it appears that the final setting time of well-aerated cement is accelerated by water having alkaline carbonates in solution, while in the case of distilled water, sea water, and water containing alkaline sulphates in solution the final setting time is not appreciably affected by aeration. Comparison of the results with reference to initial and final setting times shows a distinct lack of uniformity, the only inference being that the chemical reactions occurring in the two stages are somewhat indirectly related.

With the object of ascertaining the influence of gaging water upon the initial and final setting times of cement, without taking into account the effects of aeration, tests were made on samples of cement all aerated for 24 hours and mixed with distilled water, pure and containing different percentages of sodium carbonate in solution. These tests, conducted on briquettes seven days old, gave results showing that increasing percentages of the carbonate caused progressive acceleration of initial set and uniform retardation of final set. The investigation points to the desirability of using distilled water in tests of cement in order that results may not be obscured by variations due to the presence of chemical substances in the gaging water.—By *S. Pelham.*

Violin equipped with a "keyboard" for the aid of the beginner, and a student using the instrument with this attachment



Costumes of asbestos worn by aviators who took a flaming plane aloft to test the fireproofing process to which it had been subjected

How motor cars are shipped from San Francisco without being crated

## Live Loading of Automobiles on Steamships

THE method of handling automobiles employed by a leading steamship company at San Francisco effects a saving of from fifty to seventy-five dollars on each automobile. This saving is effected because it is unnecessary to crate the machines when handled in this manner. The company in question is said to be the only steamship company at San Francisco that can accept autos for export, without the necessity of crating them.

The automobiles are delivered directly from the railroad car and stored in a large bulkhead building. When ready to be loaded on to the steamer, the automobiles are towed to the steamerside by means of an electric tractor. A special device consisting of two pieces of timber and four cables is then attached to the automobile as shown in the photograph, and the car is raised by the ship's tackle and lowered into the ship's hold. The two pieces of timber hold the cables away from the fenders, thus eliminating the possibility of crushing or scratching their members.

This method is also used in taking aboard automobiles belonging to steamship passengers who may desire to take their machines with them.—By *C. W. Geiger.*

## Asbestos Suits for Riding the Flames

THERE has been a good deal of work lately aimed at making airplanes fireproof, or at least sufficiently so to enable the aviator to make a landing, after a fire breaks out, and before the plane is burned from under him. Of course this means, among other things, tests. Some of these can be conducted in the laboratory, but final trials must of necessity be made in actual flight, where the conditions of wind are the same as they would be in practise, and where the navigability of the plane during the fire can be demonstrated beyond question. But—what about the aviator who is called upon to make this trial flight with a burning plane—a plane which it is believed will not burn up before he makes a safe landing, but which has never been subjected to a conclusive test on this point?

Aviators are notoriously inclined toward "taking a chance," but nobody would care very much to send a man up to a possible fiery death. So the answer was found in the asbestos suit which is illustrated herewith. Aviators Campbell and Kerwood recently made such a test flight as indicated, at Atlantic City, garbed in suits like this one. To simulate as faithfully as possible the conditions that would follow a tank explosion, the plane and the aviators' costumes were liberally sprinkled with gasoline, and the match applied. Then the flame-wrapped machine took the air, and remained in flight for five minutes. At the expiration of this time the free gasoline had all been consumed, and the fire died out without a trace of damage.

Then the plane alighted, and it was agreed that the fire-proofing treatment had demonstrated its success.—By *Ralph Howard.*

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

**This device serves to iron out the dents in automobile fenders**

## Ironing Out Dented Fenders

CONSISTING of a master yoke, two arms of drop forged steel which are controlled by a long screw with a handle, a new device takes only a few minutes to get a dented fender back to health. These two arms are fastened together with a rolling slide and this permits the arms to spread as regulated by the screw. A cavity in the open end of each arm takes care of the various parts used in straightening operations.

In operation the straightening bar is applied to the upper side of the fender while the steel roll attachment is applied underneath. The bent portion of the fender is forced out or upward when the arms of the device are brought closer together by the screwing motion on the handle. When the extended arms of the cross bar are too far apart, as will occur when the curvature of the fender reaches a certain position, the screw is released slightly and the blocks are moved closer together.

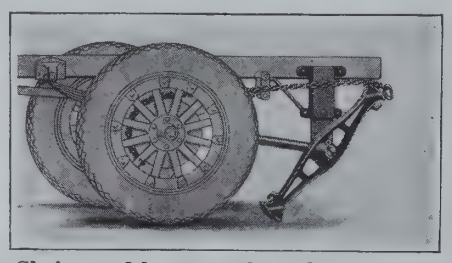
After the blocks have taken out the biggest part of the bump, rolls are attached to the clamp. All forms of fender curvatures may be treated with the device as a variety of rollers are supplied with the arm. A convex roller is used on the outside arm while the inside arm uses a concave roller and they are applied by slipping them into the ends of the arms. When the two arms are brought close together the rollers are worked over the dented surface.

Fenders are not the only part of an automobile which may receive attention from this ironer, as dents in bodies, doors, panels or hoods may be removed as well.— By *Allen P. Child.*

**The protector just under the handle protects the latter from the flame**

## Taking the Hitch Out of Motor Truck Operation

ALL roads are not boulevards, even in these days of excellent roads, and once in a great while the most efficient motor truck becomes stuck in a rut or mudhole or stretch of soft sand. Then, notwithstanding the great strength and surplus power of the modern motor truck, the wheels just spin and spin and the driver is confronted with a nice problem in tractive effort.



**Chains and levers such as these get the motor truck out of ruts and mudholes**

In order to overcome just such delays, an American inventor has worked out an ingenious motor truck attachment which forms the subject of the accompanying illustration. In brief, the attachment consists of a pair of levers and chains placed immediately behind the rear set of wheels. The levers are mounted on a shaft which, in turn, is held by sliding members. These sliding parts are provided with a series of holes, so that by removing the pins from the sleeves in which the slides are held, the shaft may be adjusted to the proper height. When needed, the levers should be pinned to the shaft as shown, with one end of each chain secured to the wheel and the other end attached to the levers. When the wheels revolve, the levers are carried to a position approximately at right angles to that in which they are shown and the chains are automatically detached from the levers after the truck has been moved forward. This forward movement of the truck can be repeated any number of times, each time the chains being connected to the opposite end of the levers as they turn. When not in use the levers and chains can be taken down and stored in a tool chest or other convenient place on the motor truck.—By *Alfred Longville.*

## Protecting the Coffee Pot Handle

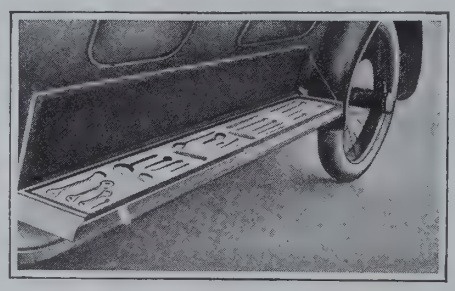
IT happens in the best regulated families—the coffee pot handle pushed too close to the gas flame, and a charred handle remains. This tin protector has been invented to be slipped between the lower horizontal extension of handle and its fastening bracket on the pot itself. It can be easily removed for cleaning and will be found handy in the kitchen.—By *K. H. Hamilton.*

## An Extra Hand for the One-Handed Card Player

IN order to satisfy his own longing to play cards and to supply a means for the half a million others who, like himself, have but the use of one hand, Henry Maier of Brooklyn, N. Y., has developed the ingenious little device shown in the accompanying illustration.

With the device invented by Mr. Maier, a one-handed man can shuffle, deal and hold the cards with fair ease and rapidity after a little practise. The machine is so simple in construction, so compact and light that it can be carried about. It is constructed of metal throughout, and contains no springs, cogs or other movable parts to get out of order. And even a two-handed person can find use for this device, when one of the hands is called upon to do other duties such as minding the baby!

The cards to be shuffled are placed in the simple holder shown in the upper part of the illustration. This holder serves to hold the pack in the same manner as one hand, while the cards are shuffled in the usual manner. The cards can then be dealt by swinging the holder about in any desired direction and throwing the card out with the one hand. Once the cards are dealt, the player's cards are picked up one by one and inserted in the curved slot which holds them as nicely as if a hand were being used for the purpose.—By *Albert Valentine.*



**Here is an idea from Germany—a running-board tool chest for motorists**

## A Tool Chest Built Into the Running Board

GERMAN efficiency no doubt has prompted a German inventor to work out a complete automobile tool chest which forms part of the running board, as shown in the accompanying drawing. The tool chest, it will be noted, is made as flat as possible so that it occupies little or no space. Recesses are cut in the tool chest in order to accommodate the various tools, so that they are firmly and safely held as the automobile receives the jerks and jolts of a rough road.—By *A. R. Surface.*

**This device serves to shuffle, deal and hold the cards with one hand**

## A Wringer for the Portable Tub

SINCE the landing of the Pilgrims at Plymouth Rock, wash-day has been known as "blue Monday," probably because of the drudgery incident to washing and wringing dry the clothes.

And as each successive invention has lessened the hardship of washing and drying the clothes, mechanical ingenuity has been thanked a thousand times. First the washing machine displaced the cumbersome scrubbing board and old-fashioned wooden tub, and other improvements followed at brief intervals. Now, thanks to the forethought of a Danville, Virginia, inventor, a simple attachment has been patented for aiding the washerwoman in wringing dry the clothes.

Instead of using all one's strength in drying the garments by hand, this bit of machinery when attached to the rinsing tub reduces the human strength necessary by one-half. Likewise the clothes are dryer by having applied the mechanical device. Instead of the water running down the sleeves of the operator, as is true when the garments are wrung exclusively by hand, the water is drained into the middle of the tub. The handy wringer is simply screwed on to the side of the tub and used as shown.—By *S. R. Winters.*

**The wringer hook and how it is applied and used in connection with the usual portable wash-tub**

# FAIRBANKS-MORSE

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THE contribution of Fairbanks-Morse to the development of America's railways has been no small one.

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Our products include Fairbanks Scales—oil engines—pumps—electric motors and generators—railway appliances and coaling stations—farm power machinery, such as "Z" engines, lighting plants, water systems.

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# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

### Pertaining to Apparel

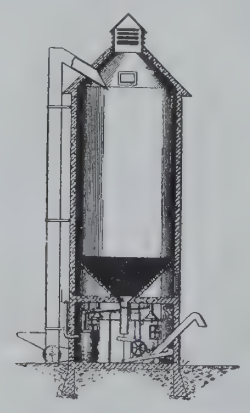
MAN'S GARMENT.—T. GONGORA, c/o Mayo Barrenechea, Box 1052, Los Angeles, Cal. The invention has for its object to provide a garment in the form of a pair of trousers which are reversible, all the seams of the garment being the same on both sides so that when the garment is turned the appearance of the turned side is the same as that of the other side, the pockets being drawn through a slit on the side of the said trousers which are provided with the usual waist band.

### Electrical Devices

INCLOSED NON-ARCHING REFILLABLE FUSE.—A. A. WELLS, 42 High St., E. Detroit, Mich. An object of the invention is to provide a simple and inexpensive fuse plug which will extinguish and choke the flame or arc incident to the fusing of the current conducting material. It is also an object to provide indicating means for showing that the fuse has been blown and no longer conducts current.

### Of Interest to Farmers

MEANS FOR HANDLING EAR CORN.—W. G. ECKHARDT, De Kalb, Ill. The invention relates to means whereby a farmer may treat ear corn fresh from the field. A more specific object is to provide a storage receptacle adapted to receive ear corn at any time after it is practically

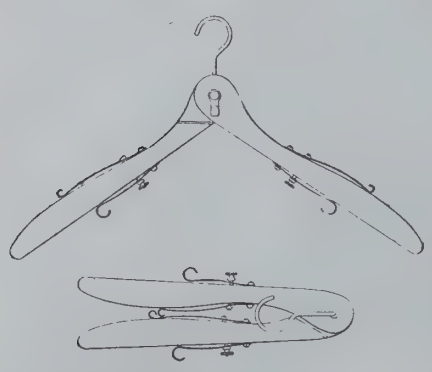


A VERTICAL SECTION OF THE INVENTION

matured irrespective of the moisture that may be contained in it, means being provided in connection with the receptacle to rapidly drive the moisture therefrom. Another object is to provide a receptacle that is proof against mice, rats, and other vermin, as well as serving as a safeguard against molding and rotting.

### Of General Interest

GARMENT HANGER.—F. L. OWEN, 1406 Commonwealth Ave., Allston, Mass. The purpose of this invention is to provide adjustable supporting spring clips with tension screws, on a garment hanger, especially adapted for



A VIEW SHOWING THE INVENTION IN OPEN AND FOLDED FORM

light dresses and waists. The device will not only prevent falling off, as is usual with ordinary hangers, but will securely hold without injury, a large number of garments, thus effecting economy both in hangers and space. A further object is the provision of a compact folding form which makes the hanger especially convenient for travelers.

DARK ROOM LAMP.—J. P. HANSEN, 10 Jacoby Allé, Copenhagen, Denmark. The invention relates to a lamp for photographic use. Among the features are that the light rays are obliged to pass colored glasses before they pass the reflector, the lamp giving an indirect light which can be easily adjusted from one color to another, or mixed at will. The lamp may also be used for the printing of bromide paper, and for the retouching of negatives.

BED.—J. S. BAILEY, care Honolulu Auction Rooms, Honolulu, Territory of Hawaii. This invention has for its object to provide a construction of vertical filler rods, and a manner of connecting the same to the upper and lower hori-

A SECTIONAL VIEW SHOWING A FILLER ROD IN CONNECTING POSITION

zontal rods of the head and foot members or side members of beds, cribs and the like, which will sustain all strains without danger of collapse. The filler rods have curved lugs at their ends, the lug at one end projecting in a direction opposite to the lug at the other end.

TOOTHBRUSH.—L. KARAS, 179 W. 89th St., New York, N. Y. The object is to provide a device of this nature in which that portion of the head containing the bristles is entirely removable so as to be renewable and thus save a great amount of expense in the purchase of new brushes, in that one handle may be used indefinitely and any number of new brush parts secured thereto. The bristles may be cleaned far more easily than those employed with the usual toothbrush.

SMOKING PIPE.—K. B. ABERNATHY, Medicine Hat, Alberta, Canada. The general object of the invention is to provide a smoking pipe with a more nearly perfect combustion to thereby consume the poisonous matter in the tobacco, to prevent the formation of deleterious and objectionable deposits which in the ordinary pipe are formed in the bowl and stem, and to provide a construction whereby a thorough cleaning of the pipe is facilitated.

INDIVIDUAL SEPTIC TANK.—H. BYRD, University, Miss. The invention relates generally to septic tanks and more particularly to a simple construction adapted for family use, and designed especially for use in connection with porous soil or rock formation, but which may be adapted to any formation, means being provided to recurrently operate to discharge only the fluid above the sediment and normally sealed by the contents of the tank.

CONVERTIBLE SWING.—E. B. BLACK, Commerce, Ga. The invention has for its object to provide a swing which may be easily converted into a hammock or reclining swing. The essential feature of the invention is a detachable plate, being connected at one end to the cushion and hinging the cushion to the seat frame so that when the strip is extended it will form a hammock. The device may be constructed of any desired material.

GATE.—H. C. HAINES, Geneseo, Ill. The purpose of the invention is the provision of a gate latch which allows the operating of the gate only when the gate is raised above the normal height, and the latch actuated while in its elevated position whereby the opening of a gate by an animal is prevented. A lever is provided for the latch which when in active position serves as a support for the gate to prevent sagging.

CUFF LINK.—R. A. GILL, Box 640, Berlin, N. H. The object of the invention is to provide a link especially adapted for connecting link cuffs with the ends inclining toward each other instead of lapped in such a manner that they will be held in such inclined position without bending of the cuff or danger of breaking the same when stiff cuffs are used.

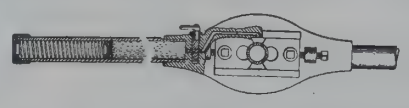
METAL MOLD AND PROCESS OF MAKING THE SAME.—J. D. MCNEILL, 9850 Charles St., Chicago, Ill. An object of this invention is to provide a metal mold from which a large number of castings can be made, thereby obviating the necessity of making a separate mold, as in sand molds. A further object is to provide a metal mold whereby the work of casting certain articles may be materially lessened, thereby tending to greater economy.

FIRE BALLOON FOR SEARCHLIGHT PRACTICE AND FOR OTHER PURPOSES.—J. U. COATES, Exeter, England. The object of this invention is to provide a simple and efficient balloon provided with a heating device comprising a reservoir containing methylated spirit or other suitable liquid hydrocarbon or fuel, and provided with fine apertures through which the vapor of such fuel may issue to be burned as it emerges, and a burner external to, but in association with, the reservoir for the purpose of vaporizing the hydrocarbon.

SHOE LACE HOLDER.—A. G. HALL, 10 Hartwell St., New Brunswick, N. J. The particular object of the invention is to provide a shoelace holder adapted to engage the bow of the shoe lace, which will be very inconspicuous and present a neat appearance and will retain the lace so that it will be practically impossible for the bow to come untied.

### Hardware and Tools

PIPE CUTTING DIE.—E. DE TEIXEIRA, East Setauket, L. I., N. Y. Among the principal objects which the invention has in view are to automatically oil an article during the process



A SIDE VIEW OF CUTTING DIE, HAVING HANDLE WITH LUBRICATED RESERVOIR

of having a screw thread cut therein, to provide a supply lubricant carried by the metal cutting instrument, and to prevent the flow of the lubricant during the inactive periods of the cutter.

GRATING.—H. H. URIS, 515 W. 26th St., New York, N. Y. The invention is more particularly intended for embodiment in street and area gratings and especially gratings of the type employing cross bars or other elements the equivalent of checker work or the like to prevent baby carriage wheels and other articles from dropping between the longitudinal bars of the grating.

SELF-SEATING DOOR HANDLE.—G. W. KENNINGTON, 414-16 3rd Ave., Brooklyn, N. Y. The invention is particularly adapted for use in connection with sidewalk, trap, or other doors which are usually arranged in a substantially horizontal position. Among the objects is to provide a handle which is simple in construction, inexpensive to manufacture and which is self-seating, forming a substantially water-tight joint and laying substantially flush with the top of the door when not in use.

MIXING VALVE OR FAUCET.—J. L. T. POPP, 630 22nd St., Niagara Falls, N. Y. The invention relates to valves or faucets used on bath tubs, basins, sinks and similar fixtures. Its object is to provide a mixing valve or faucet connected with a hot and cold water supply and arranged to permit the user to draw either hot water or cold water or a mixture of the same. Another object is to permit of setting the mixing valve for mixing hot and cold water to any desired degree. The device is simple and not liable easily to get out of order.

### Machines and Mechanical Devices

TENONING AND EQUALIZING MACHINE.—W. F. MCCARTY, Defiance Machine Works, Defiance, Ohio. The object of the invention is to provide a machine more especially designed for accurately tenoning and equalizing sticks of wood or wooden spokes for the wheels of vehicles. Another object is to cut off both ends of spoke simultaneously, and to provide one end of a spoke with a tenon for engagement with a socket in a felly of a wheel. A further object is to dispense with high skilled labor in running the machine.

FILTER.—L. WACHENBERG, Reserve Sugar Refinery, Godchaux Sugar Inc., Reserve, La. Among the objects of the invention is to provide a construction of a compact nature but having large capacity for the output therethrough, but which being relatively small and being equipped with special means for manipulation provides for the cleansing, renewal or interchange of the filtering elements with convenience, but provides ample room to accommodate a considerably large number of filter press units.

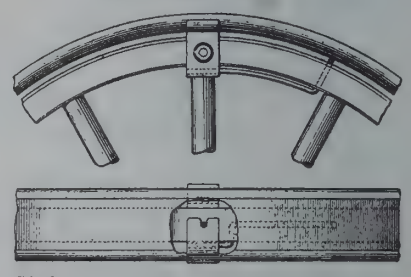
LUG-STRAP CONNECTION.—L. DURAND, 128 Oxford St., Brooklyn, N. Y. This invention relates to picking mechanisms for looms, its object is to provide a lug-strap connection arranged to reinforce the picker stick with a view of preventing the picker stick from breaking when the loom is running. Other objects are to dispense with the usual loop for stirrup straps, and to permit of applying the lug-strap connection to picker sticks of usual construction without requiring alteration thereof.

WELL BUCKET.—C. D. BEHAN, Stigler, Okla. The object of the invention is to provide a bucket especially adapted for use in bored wells, or other wells having a restricted bore, wherein the bucket is normally open at the bottom and is provided with a check valve at its top normally closed and capable of being opened manually to permit the contents of the bucket to flow out.

MACHINE FOR TRIMMING RUBBER HOSE.—F. C. MOORE, Canton, Ohio. An object of the invention is to provide a device by means of which the excess rubber which is forced out between the edges of the vulcanizing press in the final operation of vulcanizing the rubber portions of hose may be economically removed so as to give the hose a proper finished appearance. A further object is to provide a device by which the excess portions on each of the base may be removed simultaneously.

### Pertaining to Vehicles

DETACHABLE RIM FASTENER.—H. J. PRESTON, c/o Lincoln & Clay Co., Santa Clara, Cal. This invention particularly relates to fastening lugs for wheel rims. An object is to provide a fastening means involving a lug and appurtenances thereto, the use of which will accurately center the rim and positively prevent creeping. This object is attained by



A SIDE ELEVATION AND PLAN VIEW PARTLY BROKEN AWAY

providing a lug which, in addition to its primary fastening function, is provided with a secondary fastening means to secure the detachable rim at a point distant, thereby providing with each lug two points of engagement with the rim and positively locking the rim against movement.

### Designs

DESIGN FOR A MOCCASIN.—L. CHAREST, Lewiston, Me.

DESIGN FOR A PIN.—L. D. HACKETT, address A. D. Penney, Townley Bldg., Miami, Florida.

DESIGN FOR A GAME.—J. HARO, 525 W. 123rd St., Apt. 6, New York, N. Y.

DESIGN FOR A STATUETTE.—F. A. KOCH, 269 E. 194th St., New York, N. Y.

DESIGN FOR A TOY.—MILDRED E. SHUGG, 1462 Pacific St., Brooklyn, N. Y.

DESIGN FOR A POWDER CONTAINER OR SIMILAR RECEPTACLE.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal Bldg., No. 10, Brooklyn, N. Y. This invention has been granted three patents on ornamental designs of a similar nature.

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## Where the Petroleum Goes

(*Continued from page 3*)

ture should, for the American bulk production, remain practically unaltered. If, then, we find that from one year to the next we are getting out of our petroleum more of one thing and less of another, this can be fairly attributed to changed methods of treatment. Let us examine the figures for what they reveal in this direction.

The Government reports give the amount of oil fed into the distilleries in units of barrels; they give the liquid products recovered in terms of gallons; and finally they show the solid residues —wax, coke and asphalt—in tons. We cannot compare these various items on any basis of weight, for the weight per unit of bulk is the very thing that changes when we start to recover more of, say, the gasoline and less of something else. The only way in which we can attempt a percentage comparison will be on the basis of bulk; and this is perfectly fair, since any shifting of heavier fractions into lighter classifications will show up in this way.

In 1917 our refineries handled 14,487 million gallons of crude oils; in 1918, 15,817 million gallons; and in 1919, 17,096 million gallons. From this we got in 1917 2,851 million gallons of gasoline; in 1918 3,571 million gallons; in 1919 3,958 million gallons. For 1917 the gasoline recovered was 19.7 per cent of the crudes treated; for 1918 it was 22.6 per cent; and in 1919 23.2 per cent. This indicates that the definition of gasoline has been extended and the product debased by the inclusion of fractions that were formerly classified with the kerosene. You cannot increase the gasoline content of a given aggregate of petroleum by nearly 18 per cent unless you thus admit as gasoline something which was not previously admitted. If the 1917 definition of gasoline were to be enforced today, we should have had but 3,367 million gallons of "petrol" for 1919; the shortage would have been worse and the price higher, but as a partial offset the quality would have been better.

If we investigate the kerosene fraction to see what its loss was, we find what may at first be a surprise. The only place from which we can borrow near-gasoline is the kerosene fractions; yet in the face of this fact and of the evidence that we did so borrow, the kerosene recovery was 11.9 per cent (1,727 million gallons) for 1917, 11.5 per cent (1,825 million gallons) for 1918, and no less than 13.5 per cent (2,342 million gallons) for 1919. The answer, of course, is simple; we borrowed from Peter to pay Paul —or dropping figures of speech, what the kerosene fractions lost at the top to the gasoline, they got back with interest at the bottom from the fuel-oil group. Kerosene as well as gasoline has had to be debased to keep up with the procession.

The gas-oil and fuel-oil fractions that comprise the next group represent the biggest single item in oil refining. For 1917 45 per cent of the crudes went in this direction (6,513 million gallons); for 1918 46.3 per cent (7,321 million gallons); and for 1919 44.6 per cent (7,627 million gallons).

The very essential lubricating oil comes next in the scale. This accounted in 1917 for 5.2 per cent of the crude oil refined (754 million gallons); for 5.3 per cent (841 million gallons) in 1918; and for an even 5 per cent (847 million gallons) in 1919. So here, too, we fail to find a shrinkage which would indicate an end of the borrowing process; the lubricating oil supply must have been stretched by falling back upon some of the still heavier components, which had previously been allowed to remain in the solid residue of the refining process.

The Government statisticians recognize, in addition to the four major groups covered so far, a classification of miscellaneous character. We may get some idea of what this covers by examining the detailed analysis furnished for 1919, showing its make-up to the last detail, even to 105 gallons of "ink oil." We find listed here such items as binder, flux, petrolatum, road oil, sludge, distillate, medicinal oils, etc., etc. This miscellaneous caption in 1917 accounted for 4.9 per cent (703 million gallons) of the crude oil treated; in 1918 for 8.1 per cent (1,287 million gallons); and in 1919 for 7.5 per cent (1,279 million gallons). Finally, we are told that refinery losses from evaporation and other causes are held accountable for 549 million gallons of material in 1917, representing 3.8 per cent of the total; and for 611 million gallons in 1918 and 672 million gallons in 1919, in each case 3.9 per cent of the supply of crude oil.

The three solid residues of wax, coke and asphalt are listed in tons, and without data as to their specific gravity it is of course not possible to put them on a gallon basis. They represent, however, whatever of the crude oil has not otherwise been accounted for. On this basis, the 1,519 thousand tons of wax, coke and asphalt produced by the refineries in 1917 must be taken as accounting for 9.5 per cent by bulk of the petroleum treated; while the 1,420 thousand tons of 1918 and the 1,739 thousand tons of 1919 in each instance represent but 2.3 per cent of that bulk. This puts us on the ultimate trail of the borrowings made from Peter for the benefit of Paul. If a greater tonnage of solids in 1919 than in 1917 represents barely one-quarter as high a percentage of the bulk of raw material, we have a verification for the very natural assumption that as we pass upward in the scale of specific gravity, robbing each series of its lighter elements to enrich the preceding series, the final and heaviest series must finally have to pay the bill—there is nowhere for it to turn for replenishment. The figures indicate very clearly that this progressive transfer from heavier to lighter classifications all along the line is precisely what has happened, precisely the manner in which the supply of petroleum products has been stretched so close to sufficiency as has been the case. The various petroleum distillates have been promoted; parts of the old kerosene fraction have been admitted to the gasoline group, the kerosene supply has been recruited from the fuel oils, these in turn from the lubricants, and finally the latter have been forced to admit constituents that were formerly allowed to remain behind as solids.

The variable character of petroleum is further demonstrated by the peculiar showing of the solids, in the classification by sections of the country for 1919. The Atlantic Coast refineries get close to 11 pounds of asphalt out of every barrel of oil treated; the Oklahoma-Kansas and the Colorado-Wyoming fields together extracted but 192 tons of asphalt from 88,000,000 barrels of crudes. The Indiana-Illinois field produced petroleum running 8 pounds of coke to the barrel, while there was not a pound of coke recovered from the California oils, which, however, were richer than the average in asphalt. Finally, as against 4 pounds of wax to the barrel of Pennsylvania crudes, the petroleum from the California field shows less than half an ounce of wax per barrel. For the United States as a whole, the petroleum shows 1.1 pounds wax, 2.98 pounds coke, and 4.4 pounds asphalt per barrel of oil. The oil-barrel, by the way, contains 42 gallons.

It will be of interest and importance to watch statistics for future years and see just how far and how fast we go in the process of pushing our motor fuel down the scale from gasoline to kerosene. Some of us, when we try to start our cars on a regular winter day, are prepared to believe that we have already gone most of the way; but future performance will probably show how hasty this supposition would be.

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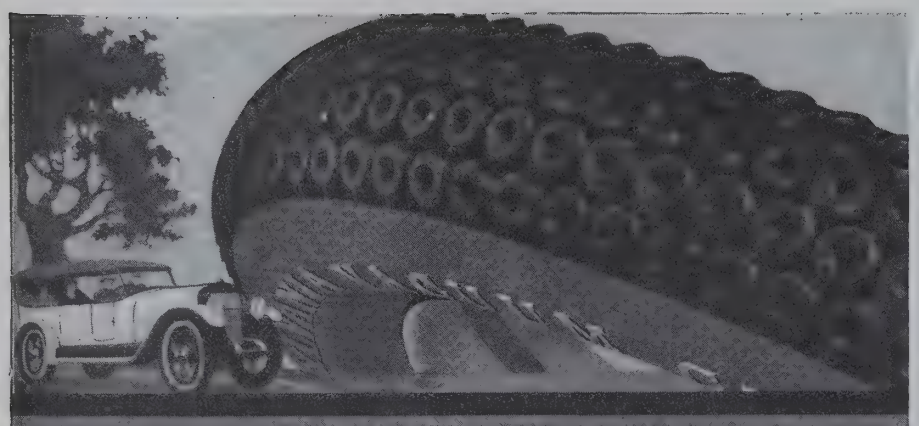

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## Romance of Invention—XIV

(*Continued from page 8*)

University of California, anywhere from the Department of Botany to the Department of Physiology: "Oh, go tell Cot about it. He won't know anything about your subject, but you won't talk to him ten minutes before he'll give you an idea.'" And this seems entirely characteristic. His own work he credits largely to those who have worked with him, but it remains for others to refer to him as a catalyzer of men. Catalytic processes, it will be recalled, are those in which some agent produces results while remaining itself unchanged. And Cottrell seems to have that type of mind, which inspires in others new thoughts, new ideas, often new ideals, without such inspiration taking anything from his own brain. Thus, the demulsification of the California oil well water was solved by a suggestion of Cottrell's, a thing for which he takes no credit, yet which is surely his, since he but applied to the problem the same methods and the same reasoning which solved the electrical precipitation problem of solid matter from gases.

The first installation of the Cottrell process in commercial work was at the Hercules Powder Plant at Pinola, California, where there was a small sulfuric acid plant. A twenty thousand volt current was used, the insulated high potential electrode being covered with pubescent (hairy) asbestos. It was successful but the plant was too small for it to operate at a profit. Nearby, however, was the Selby Smelter, a large plant near a tunnel of the Southern Pacific Railroad, which tunnel was frequently fouled with the sulfur trioxide fumes from the silver dissolving house. Legal proceedings by the railroad threatened to stop the operation of the smelter. Then came Cottrell to the rescue with a small electric plant which is running today, and the harmful fumes were caught and metamorphosed into useful dilute sulfuric acid, which became a by-product of the smelter. The tunnel was cleared, legal proceedings were stopped and the Cottrell process was on the map. Fume-pestered farmers all over the West who had sued smelters right and left succeeded, with the Selby plant example before them, in convincing judges and juries of the fact, that they were not asking the impossible of the smelters when they demanded suppression of the fume nuisance, but only asking for needed relief which could be readily obtained.

As the fume problems of the various industries differ so widely, it is obvious that special apparatus and special arrangements must be made to cope with each. But there have been none which the engineers of the Research Corporation have not been able to solve. By having the patents in the hands of engineers whose desire is to get the process working, to get it in the hands of those who can use it, and who are asked to pay, not a huge personal profit, but merely a nominal license profit, which is turned into the corporation for further scientific work, there is eliminated all the matter of money-making expediency which so frequently retards, rather than develops, an invention. The Research Corporation is paying its way, is spending more a month than it originally had capital for a start, is employing a large staff to do its work and has established a Fellowship in Applied Science, awarded yearly, to stimulate scientists, inventors and discoverers to further research and assist them in such labors.

Dr. Cottrell prefers to work where he is of the most use rather than where he will make the most money. He seems to prefer to spend his life (he is forty-three years old) catalyzing other men into mental activity, making new discoveries himself, furthering the comfort and convenience of the world at large than in developing a big income for himself.

But if he builds no monument of wealth to his name, he has done that which is of infinitely greater worth. To a world just learning how unnecessary any waste may be he has given a very potent means of saving waste, and devoting the profits of his wonderful discovery to the increase and wider diffusion of valuable knowledge among all men. More power to him, and may there be others like him in the days to come.

## Baltimore's Tilting Dam

(*Continued from page 12*)

friction due to corrosion, etc., at the pin tends to increase the head required.

It should, of course, be understood that the diagrammatic section is much simpler than the real thing, composed as the latter is of timber and metal parts. The slanting upstream face which restrains the water for a time is a wooden diaphragm bolted to a metal frame. In one type of unit there are two triangular frames of angles and plates. These are set 8 feet apart, center to center. On the upstream edges of the frames are bolted three I-beams which serve a purpose similar to that of joists. The wooden decking is bolted to them after the manner of flooring. However, this decking presents a surface 12 feet long, measured parallel to the dam, and a little over half as broad, measured from toe to crest. Anchor blocks of metal were installed for the purpose of providing a means of pivoting or hinging the unit dams to the top of the masonry construction. As the crest was provided with keyways which are to be used when in the future the dam is enlarged in thickness and height, the center one was utilized as a suitable depression in which to secure the anchor blocks. When a block is in place the axis of the pivot hole is 2 inches above the masonry crest.

The manner of fixing the anchor blocks securely in place is of interest. An anchor block consists of three separate castings. The principal one has the pivot hole. It was readily set in place in the rectangular groove in the top of the masonry. The remaining two pieces were then slid in to approximate position. Each of these pieces had a toothed surface to present to the vertical wall of the groove. One was located on the upstream and the other on the downstream end of the main block. By means of wedges, these two pieces could be made to extend the body of the main block so as to fill the masonry groove from one vertical face to the other. If, now, their positions could be rigidly maintained, the block should be held very firmly indeed against any overturning action exerted through the pivot. In order to meet this requirement, space underneath the casting was left when setting it and this was later on filled with a grout made of cement and sand (1:2); and the interstices between the small castings and the big one were filled in with lead.

The frames of some, at least, of the units were so dimensioned and shaped that upon tilting the foot D rests in the next keyway downstream. At this juncture, the wooden face, while tolerably flat, has not yet reached a full horizontal position. This means that some amount of face is still presented to the oncoming water. However, after making all deductions for this face and part of the framework, there is a clear opening, for this type, nearly 15 inches high. Here the water flows over the masonry crest and beneath the wooden face.

A question that may now be put is this: Will the dam, after it has once tilted, reverse itself upon subsidence of the water? Usually, the dam reverses, it is said, when the water falls to elevation 188.75 feet or a little less. This would seem to mean that when the depth of water on the masonry crest gets down to 9 inches or something less, the center of gravity has moved over to a position a trifle upstream from the pivot.

# Five Men Around the Table

## *Automobile History in the Making*

***Henry M. Leland, Wilfred C. Leland and some of their Associates in the Lincoln Motor Company***

AROUND a table in a modest office some eighteen years ago, five serious-minded men sat in consultation. They had sat in consultation many times before. For a number of years these same men had worked and thought and studied and planned together, always with the same objective—to do things better and to make

*A conference of 1902 which marked the sunrise of America's motor car industry.*

things better than they had ever been done or made before—in fine machinery, fine tools, and internal combustion engines.

"Yes, boys, that's good, but it isn't quite good enough." It was the eldest of the group who spoke. "This piston fits perfectly into this particular cylinder," he said, "but we must make every piston so exact, and every cylinder so exact, that every piston will fit perfectly into every cylinder. Then, if anything happens to either, it can be replaced by another; and the car owner will not be obliged to buy both cylinder and piston if only one should be injured.

"And this wrist pin," he continued, "must be made accurate to the half-thousandth of an inch. Its bearing must be made with the same precision. Then there will be a perfect fit, and practically no wear-out to it. Otherwise, the slightest 'play' means early wear, and destruction."

And on, and on, and on, the conference continued for hours, and was resumed day after day—until the last bolt and nut had passed scrutiny.

Earnest and thoughtful, tho these men were, little did they dream of the far-reaching influence of that council upon what was to become one of the world's greatest industries, an industry which has now become one of the great factors in civilization.

The leaders of that history-making conference in 1902 were Henry M. Leland and Wilfred C. Leland.

They were discussing and passing judgment upon an automobile design, upon specifications and materials; and determining upon the accuracy to be followed in making the various parts— accuracy expressed in thousandths of an inch, and even in fractions of a thousandth.

Three cars were completed, and subjected to most rigorous treatment. Materials were ordered to build three thousand of them. These were eagerly absorbed and more than twenty thousand were distributed within the next five years.

It is strikingly significant that many of these original Leland-built cars are still in service; and many of the engines after eighteen years are doing duty in stationary power work—in the small shop, and on the farm.

It was this Leland-built car which brought honors to America when it was awarded the Dewar Trophy—a tribute bestowed annually by the Automobile Club of Great Britain in recognition of the greatest advance in automobile development.

*The same five men in 1920, in a conference which presaged new and better things in motor cars*

From a number of cars in stock, the Club's technical committee selected three. These cars were entirely disassembled, down to the very last piece. The parts were then mixed promiscuously. Eighty-nine parts were withdrawn and replaced by like parts from service stock.

Mechanics then assembled three "new" cars with parts taken at random, there being nothing to identify their original assembly. Not so much as file or emery cloth was used, or needed; yet every part fitted as perfectly as in the car from which it was taken.

In many instances, inaccuracy of the thousandth part of an inch—even inaccuracy so fine as a third of the thickness of a hair from your head—would have meant failure. But the test was an unqualified success.

The profound impression made upon the manufacturing world by that remarkable achievement, thousands will still recall.

It immediately compelled recognition of the Lelands as foremost exponents of precise workmanship and true standardization—a recognition more complete today than then.

A few years later, another Leland-built car was awarded the Dewar Trophy. This time it was the result of the eminently successful test of the then new electrical system of automatic cranking—lighting—ignition.

Leland-built cars were the only American product ever to receive that much coveted tribute, and the only make of car thus honored twice.

In 1914, twelve years after the conference first here pictured, there was another series of consultations. These men were now developing, modifying and refining the V-type eight cylindered engine with which the Lelands were once more about to revolutionize the trend of fine car making.

January 7, 1920, five men were again in conference. They were the identical five men who were around a table eighteen years before. They had been in continual relation for more than twenty years, always with the same objective—to do and to make things better—to build motor cars better than they had been built before—cars of greater comfort, greater convenience and greater utility.

They are men who have inaugurated many epoch-making periods in the more important motor car developments.

In the conference of January last, the same five men, with scores of earnest, loyal associates, were preparing to inaugurate another epoch-making period; this time the new Leland-built car—a car such as thinking men and men who know the Lelands would naturally expect.

It is a car not only the outgrowth of eighteen years' experience and devotion to fine car making, but a car expressing, more truly than ever before, Leland foresight, Leland courage, Leland initiative, and Leland determination to achieve—and to surpass.

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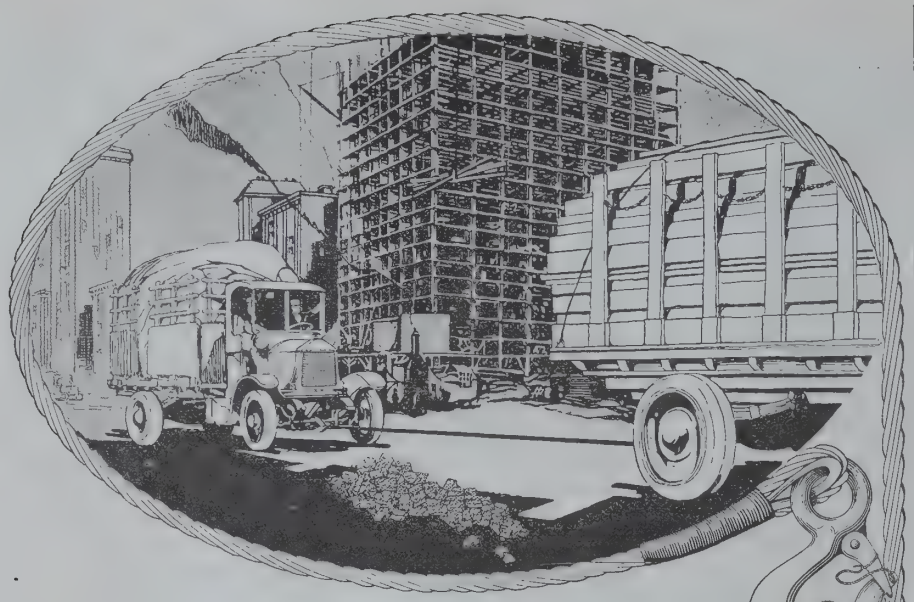

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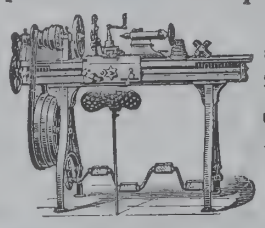

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## How Plate Glass Is Made

*(Continued from page 14)*

gage the production of plate of any desired thickness. The semi-fluid glass is now poured from the pot on to the table, and a huge roller passes over it, ironing it out into a layer of uniform thickness. This might seem to be the end of the matter, but there is still a lot to worry about before that sheet of glass is ready for the market.

In the first place, while now substantially solid, it is still far from cool; and if allowed to cool without special treatment, it would crack, curl, shrivel, and do all sorts of unpleasant things. So it goes to an annealing oven, where its temperature is brought down by slow and easy stages, in such a way that no damage to the plate results. On leaving the ovens, it doesn't look much like the beautiful smooth sheets of plate glass which we see in the store windows. Its surface is rough, opaque, altogether unprepossessing—but only the surface, for inside it is clear as crystal. So it goes to the cutter who takes off the rough edges and squares it to the proper dimensions; and from his hands it passes to the grinding room.

The grinding table is a big revolving platform of iron. It is prepared for action by being flooded with plaster of paris and water; then the slab of glass is lowered upon it with the utmost care, men climb on top of it, and tramp it into place until it sinks well into the plaster and the latter sets about it. Still greater security is got by pegging with wooden blocks; then the table is at length set in motion. The grinding is done by revolving runners. Sharp sand is fed on to the glass, and a stream of water constantly flows over it. After the first cut by the sand, emery is substituted, and then finer emery, and finer still. At the conclusion of the grinding process the plate is carefully inspected. Nicks, fractures and flaws are found, and the plate is squared upon again in smaller size or sizes to eliminate these, or if they are too serious to permit this, it is fed back into the pots as cullet, or broken glass, of which a certain proportion goes into each charge. The parts that get past this inspection are polished much after the same style that regulated the grinding operation, the only difference being in the abrasives, which are here of course much finer. Rouge (iron peroxide) is the standard here, and it is worked over the glass with felt runners, so arranged that every part of the glass passes under every part of the runners, tending to compensate for any slight irregularities.

Altogether the grinding and polishing reduce the plate to about one-half its original thickness, or even less. The material washed away represents a permanent loss, since it is so commingled with the abrasive particles that it would not be profitable to attempt its recovery. New plate glass is a delicate sea-green, when viewed through the edge. When exposed for a period to sunlight this fades slowly to a yellow or light brown, which makes it difficult to match new glass in with old.

When the plates are to be bevelled, a good many additional processes are necessary. The roughing mill or roughing wheel is a circular cast-iron disk having a fine-cut corrugated surface about thirty inches in diameter. This revolves rapidly, while sand or carborundum is conveyed to it from above through a hopper with a stream of water, the sand giving the desired roughness between the iron and the glass while the water minimizes the frictional heat. The edge of the glass is brought into contact with the swiftly moving roughing wheel, which revolves in a horizontal plane, and the sand cuts the bevel to the desired depth. Curves and patterns with incurves, miters, etc., require great skill on the part of the operator. Then a second roughing process follows in a second mill, with a finer abrasive, designed to smooth out some of the troughs left by the first cut. After this a mill of fine sandstone, with no intermediary save water, is employed for what is known as the smoothing out. The polishing wheel brings the surface of the bevel to a dull, milky finish by means of powdered pumice. Then comes the final high-gloss polish, effected with rouge and a layer of heavy felt.

The edge of the glass, according to the use which it is intended to make of the plate, is rough ground, squared, or chamfered as desired, and often is polished much as is the bevel. Ornamental lines are frequently cut about the edge, etc., and this is done with a very sharp-edged wheel in the first instance, followed by polishing operations.

## Orchard Medicine Quacks

OUR idea of a genuinely discouraging farm experience is that of a Pennsylvania orchardis who, in a conscientious effort to control pests, used the wrong spray material and killed 22,000 trees. This orchard tragedy stands out be cause it is exceptional as to size, but it could be matched as to essence by thousands of other authentic instances. Like drinking medicine in the dark out of a bottle labelled with cross-bones, is the use of the wrongly picked or wrongly applied fruit spray. Because the appearance of dangerous orchard pests, reaching now to practically every section and locality, makes spraying absolutely necessary, the danger in the situation, unless care is taken, bulks large.

And a deplorable, and widespread fact, is that most such orchard tragedies happen to progressive, enterprising fruitgrowers, men who oftentimes are experts in their line. It was thus with the orchardist who lost 22,000 trees. The error in most cases comes in following advice—for this new department of fruitgrowing is one on which the average grower must seek information—given by irresponsible, unreliable people, the quacks of the "tree medicine" business. In a financial way, a vicious patent medicine can play about as much mischief in the farmers' business as it can anywhere.

Ultimately authorities will see to it that farmers are adequately protected against quacks and frauds, but until this day is fully here, the safe thing is to go straight to the state college or experiment station fo radvice on a ticklish subject, and then adhere strictly to the directions given.—By *J. T. Bartlett.*

## Moisture Absorption Through Varnish

IN experiments made by the Forest Products Laboratory, it was found that varnishes do not entirely prevent the transmission of moisture into wood but merely retard it, and that apparently there is no difference in moisture absorption through the coating due to the species of wood used.

The panels used in the experiments were of yellow birch, basswood, red gum, African mahogany, white ash, white pine, Sitka spruce, southern yellow pine, bald cypress, incense cedar, white oak, western yellow pine, Port Orford cedar, and sugar pine.

Three coats of high-grade spar varnish were applied to 4 panels of each species. Two panels of each species were brush-coated and two were dipped by a special dipping machine designed to secure an even coating. The panels were allowed to dry 72 hours between coats and 10 days after the final coat before they were given the moisture-resistance test.

The moisture-resistance test consisted in exposing the panels for 17 days to a humidity of 95/100 per cent, or in an atmosphere practically saturated with moisture.

At the end of this test, it was found that all the brush-coated panels had absorbed between 5 and 6.5 grams of moisture per square foot of surface, and the dipped panels between 4 and 5 grams.

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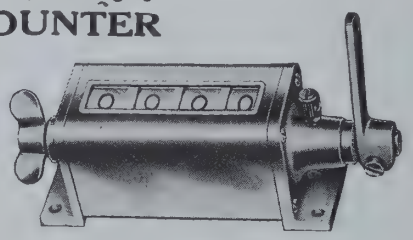

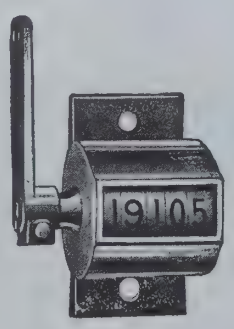


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# The Naturalist's Corner

## Botanical Notes from All Quarters of the Globe

By H. A. Gleason, Ph. D.

**A Newly Introduced Weed.**—The Japan honeysuckle, which has begun to run wild in the eastern and southern states in the past two or three decades, is an interesting example of a woody-stemmed weed, according to E. F. Andrews in *Torreya*. Formerly seen only in cultivation, it is now firmly established in woodlands and along stream borders in many localities, where it makes an almost impenetrable jungle with its tangled climbing stems and frequently smothers completely the plants which it covers. It trails on the ground when a support is not available, and it is suggested that in this habit it may have some economic value in preventing or reducing soil erosion.

**Blueberries in Cultivation.**—A tall species of blueberry which grows wild in the swamps of northern Florida has recently been introduced into cultivation through the efforts of Mr. M. A. Sapp of Pensacola, Florida. About 20 years ago Mr. Sapp selected 100 wild plants that were producing unusually good fruits and transplanted them to a cultivated and well-drained field. The plants thrived and fruited more abundantly than when growing in the natural habitat, and the fruit found a ready market at once. The plantation was enlarged until it now covers over eight acres. The annual yield is about 3,200 quarts per acre and the entire crop finds a ready sale at 10 to 12½ cents a quart. Several rather distinct types of plant in respect to habit of growth have been found and there is considerable variation in the quantity and quality of fruit produced by individual plants which gives opportunity for improvement by selection. The most desirable type for commercial culture is one that grows to a height of about eight feet and has a compact and freely branching habit of growth with fruit well distributed over the branches. The berries range from 10 to 14 mm. in diameter. The quality of the fruit is quite like that of the northern blueberry, which has also recently been domesticated and greatly improved.

**Vinifera Grapes in the Eastern States.**—Through recent experiences with vinifera grapes in California, horticulturists have learned that the failures of the early attempts to cultivate this grape in the East were due chiefly to the attacks of fungi, such as powdery mildew, downy mildew, and black rot, the serious injuries of a parasitic root-sucking louse called the *phylloxera*, and winter injury. It is now known that all these destructive agencies can be controlled. Actual demonstration of this has now been made at the Geneva Experiment Station, where for the past six years varieties of vinifera grapes have fruited satisfactorily. A report has already been published describing cultural requirements and methods of propagation, and giving a list of the most desirable varieties of table and wine grapes suitable for culture in New York State. Compared with the fruit of our native varieties these of vinifera are more solid, the skin adheres to the flesh, there is a higher sugar content, the flavor is richer, and the fruit keeps longer in storage. It appears certain that viticulture in the eastern United States is to be extended and greatly enriched in the future through the successful cultivation of pure and of hybrid strains of the European grape, the culture of which in the Mediterannean region dates from prehistoric time.

**Fictitious Botanists.**—Science deals with facts, but some supposed scientists are only a fiction! At least so Dr. J. H. Barnhart reports in a recent article in the Journal of the New York Botanical Garden. He finds that a well-known cyclopedia lists a number of such imaginary persons and discusses fourteen of them in detail. They are all described as Europeans, mostly of the eighteenth and early nineteenth centuries, who traveled extensively in what were then little-known regions of the two Americas, collected diligently, made important observations, and then returned to Europe to publish their discoveries in thick volumes with resounding titles. Dr. Barnhart infers that the same cyclopedia may contain other names equally fictitious.

**Origin of the Loganberry.**—It now appears that the plant that has recently become well known as the loganberry is a red-fruited variety of a trailing blackberry that grows wild on the Pacific coast, rather than a hybrid between this blackberry and a raspberry. Such is the view given by George M. Darrow in a recent Farmer's Bulletin from the Department of Agriculture. Mr. Darrow calls the plant the "Logan blackberry," in reality therefore a red-fruited blackberry. It is reported that this variety is distinguishable from certain black-fruited varieties only by the character (chiefly the color) of the fruit, and that there are also wild forms of the species which have red fruits. It is clear, however, that the original seedling of the Logan blackberry was grown from a seed taken from a black-fruited plant that grew in Judge Logan's garden. The Logan blackberry is found to be adapted to culture in the milder parts of the Pacific coast states. The variety does not thrive in any of the central or eastern states and thus far no strains adapted for culture in these states have been developed. Several forms of blackberries and blackberry-raspberry hybrids that closely resemble the Logan blackberry are also described.

**Is It Necessary to Fertilize an Apple Orchard?**—The answer to this question is being sought in the results of a carefully conducted experiment at the State Agricultural Experiment Station at Geneva, New York. The experiment has already been in progress twenty years, and the results to date have recently been reported in a bulletin from that station. Each year the same kind of fertilizer is applied to the individual plots on which five trees are growing and the results judged by comparing the yield and the size of the fruit and the tree growth with that of trees growing on unfertilized or check plots. The results of the first seven years of harvest have shown that the trees in this experiment would have been practically as well off had not an ounce of fertilizer been applied. During the later years the continuous applications of acid phosphate alone and of stable manure have continued to produce no noticeable increase of yield; potash and acid phosphate together have produced a slight increase in yield, but this has not been increased further by also adding nitrates. On the whole the differences in fertilized over unfertilized plots have been so slight that the use of any one kind of fertilizer or combination of them cannot be recommended. The use of fertilizers is hence found to be of doubtful profit for commercial orchards, at least during the first twenty years of the life of a cultivated orchard grown on a clay soil that is naturally rich in phosphorus and potash.

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### Better Concrete

IN a series of tests at the University of Texas, specimens of concrete prepared with an excess of water showed a considerable reduction in strength, as compared with mixes in which only enough water was used to secure a concrete of workable consistency. Now in practical operation it is absolutely necessary to use enough excess water, over the minimum requirements of mixing, to make the concrete sufficiently fluid to be handled in wheelbarrows, carriages, etc., and so that it will flow readily into the form, and between and around the reinforcing steel. This means that an excess of water must be employed to place the concrete correctly and economically, and that this excess water materially reduces the strength of the concrete. The question arises whether something cannot be done to counteract this unfortunate effect.

To answer this Mr. G. A. Parkinson of the University staff made efforts to remove the excess water after the deposition of the concrete in the forms. If a pointed iron rod is forced into the concrete while it is still soft, he found that the excess water and likewise the entrapped air is permitted to escape upward, compacting the aggregate and increasing the density by some four per cent. This method of treatment has been called rodding; emphasis is placed upon the fact that while quite similar to spading, it differs materially from tamping.

Some of the results of the rodding tests are of great interest. The same procedure was gone through with fifty-four cylinders, six by twelve inches each, divided into three groups of eighteen each. In each group one cylinder was not rodded at all, one was rodded once, one twice, and so on until one was rodded seventeen times. In one of the three groups ten-minute intervals were allowed between successive roddings of a given cylinder; in the second group these intervals were increased to twenty minutes; and in the third to thirty minutes. In every case the first rodding was applied soon after the molds were filled, without waiting for the full interval assigned the series to elapse.

A single rodding, it may be necessary to state, does not mean a single thrust of one rod. It means the pushing of a rod into the concrete, to the full depth of the latter, once for every three square inches of surface area—or in the case of the test cylinders, ten times.

It is interesting to note that the maximum strength of rodded cylinders is about 130 per cent of that of the unrodded specimens. All three series acquired their maximum strength in about two or two and a half hours, though of course with different numbers of roddings. That is to say, for the 30-minute interval it required five roddings; for the 20-minute interval seven roddings; and for the 10-minute interval fourteen roddings, to attain maximum strength. It seems probable that the length of time and the number of roddings necessary vary with the temperature and with the percentage of water present in the first place.

The rodding was also tried with three groups of cylinders in which the mix contained, respectively, four, six and eight sacks of cement per cubic yard, while in the individual cylinders of each group the water content was varied. Comparing the results with the standard formulæ for the strength of plain concrete, formulated by Professor Abrams of the Lewis Institute, it appears that the effect of rodding is more beneficial with lean than with rich mixes, and that as might be expected it is more beneficial with wet than with dry mixes. Thus, the average strength of 8-sack concrete was increased only 45 per cent (approximately by rodding), and that of 6-sack mixes some 60 per cent; but with the very lean 4-sack mix the improvement was around 220 per cent.—*F. E. Giesecke.*

## St. Louis Needs Shoe Findings

ST. LOUIS, the largest shoe center in the world, lacks factories for the manufacture of shoe findings—such as laces, threads, shanks, hooks, nails, tacks, eyelets, buttons, heels, rubber heels, cloth linings, etc. These products must now be bought in the East. Most of the raw materials are shipped from the Mississippi Valley, manufactured in the East, and shipped back to the world's greatest shoe city—St. Louis.

The output of shoes in St. Louis this year will total approximately $175,000,000. The St. Louis shoe manufacturers spend more than $10,000,000 annually for shoe findings. A Mid-West factory in St. Louis could supply the trade here and economically reach all Mississippi Valley, South, Southwest, Middle West, and Far West markets from this central distribution point. Shoe findings is but one of the following sixteen industries St. Louis is seeking:

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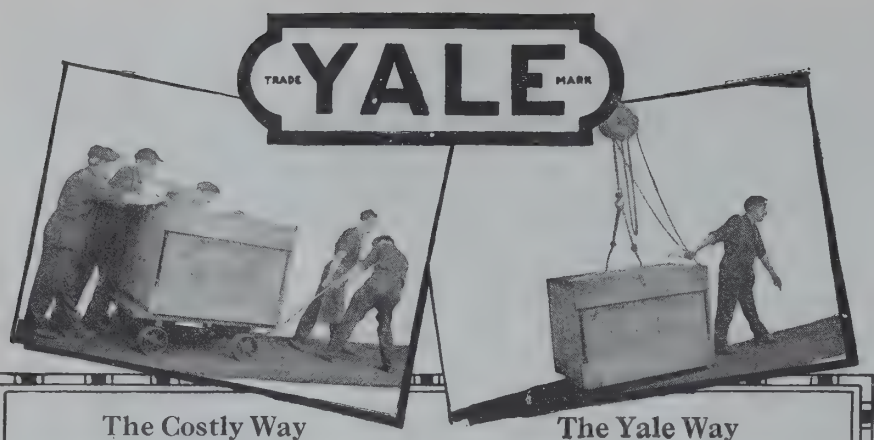


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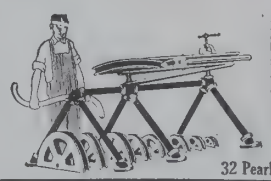

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(14326) H. H. asks: A person born on Easter Sunday, April 21, 1889, when will his birthday fall on Easter Sunday again? A. The next time when Easter Sunday will fall on April 21st is in 1935, then in 1946, and in 1957. These are all the years of this century when Easter will occur on April 21st.

(14327) W. J. M. asks: I have had a problem bothering me for some time on which I should like to hear the opinion of anyone who thinks he has a solution. It is known that the sun has its heat replenished to a considerable degree by impacts of numerous meteorites upon it. As this process goes on, the sun is constantly growing larger, not appreciably but undeniably, by the addition of the masses of these falling bodies. This, which is true of the sun, is just as true of all other heavenly bodies. Furthermore, as these bodies grow larger by these additions, their attraction becomes greater and not only do the meteorites fall at increased speeds but more of them fall. It is apparent the universe as we know it could not exist for long in this state.

With what I have just said in mind, I see only two ways of accounting for the existence of the universe as we know it. Either the universe has been "condensing" throughout infinity from an infinitely fine gas to its present state with unit matter as its final goal or there is some agent at work to keep this from happening. If the first is true we have added another remarkable coincident to the already great number that we accept to explain the existence of the human race. If the second is true, the force which balances our universe must be of a very interesting nature, scientifically. The probabilities are very much against the first theory.

Can it be possible that a body can become so large that its own weight will cause the atoms at its center to be broken up into some basic material, such as that which we call ether, which will then filter out to recondense in the form of matter when conditions become such as to make it possible? A. Astronomers are agreed that the weight of meteors added to the earth or the sun in any moderate period of time such as a century is very small, too small to appreciably affect its mass. If there was such an effect it would cause a decrease in the size of the orbit of a planet and cause it to approach the sun. If as some think there may have been a more rapid accretion of meteors in remote past ages than this effect may have been experienced to a degree. You will find this topic treated at some length in Moulton's Introduction to Astronomy, which we will send you for $3.10.

(14328) K. C. A. asks: Please let me know method of filling a barometer tube so as to get complete vacuum and proper height of mercury column. A. Filling a barometer tube properly so as to include no air is not easy. The mercury should all be boiled in the tube. Put in not more than four inches and boil it by heating carefully and slowly over a flame. Herein lies the difficulty. If you do not heat quite a section of the tube, at least six inches it will break. Or if you heat the tube unequally it will suddenly break. Probably the experts heat the tube in a sand bath. When one section has been boiled to expel the air and has cooled another similar length may be filled and boiled as before. You will probably break several tubes in getting experience, but if you succeed you will have a barometer to be proud of. Usually amateurs take a wire with a small swab of absorbent cotton twisted in at the end and run this swab to the bottom of the tube. Then fill the tube with mecury and draw the swab slowly out. The cotton will bring with it nearly or perhaps quite all of the air in the mercury and on the glass in the tube. You should get much better than 29 inches at sea level with a barometer filled with the swab of cotton employed to draw out the air. You can get the correct reading of the barometer at the Weather Station in your place.

(14329) W. M. D. asks: Please tell me what the message from Mars was and where received, and when. I would like all information that I could get on Mars. A. There were certain sounds heard on the wireless apparatus which could not be made out. They were not words nor anything like our language. These disturbing noises were not explained by anyone. Some one suggested that they were signals sent from Mars. There is nothing more than that in this matter. It is very unlikely that any signals could be sent from Mars to the earth. We cannot now send half way around the earth, 12,000 miles. How could we send 35,000,000 miles to Mars? Nor have we any reason to think that the inhabitants of Mars, if there are any, would have the same language as our English speech. We could not talk with an inhabitant of Central Africa, how then with a Martian? There is little or nothing in the notion that signals have reached the earth from Mars.

(14330) F. H. M. asks: "What would be approximately the number of cubic feet air inhaled by a person during 8 hours' sleep? About what per cent of oxygen is used from the air by the body in breathing? Does air exhaled have greater specific gravity than air inhaled? Would such air have a tendency to settle to the floor of the room?" A. The average capacity of the human lungs is one gallon, or 231 cubic inches, but the average inhaled and exhaled at a breath is taken at about 30 cubic inches, thus the air is gradually changed in the lungs and their delicate surfaces are not exposed to the chill of air of a temperature much below their temperature. We may assume 15 breaths per minute as normal, and thus it may be calculated that we inhale about 375 cubic feet of air a day. This is vitiated with 4 per cent of carbon dioxide. This will vitiate 1,500 cubic feet of air to one per cent. This is *bad air*. If 4 parts in 10,000 of carbon dioxide are taken as the least to be permitted a man would require 37,500 feet of air each 24 hours. The oxygen removed from the air in 24 hours is enough to make the carbon dioxide. This may be calculated without difficulty. The exhaled air is hotter than the air of the room and thus at first rises. The carbon dioxide in it does not greatly increase its weight or density. Then, too, the carbon dioxide rapidly diffuses into the air of the room and will in time be found in all parts of the room.

(14331) V. T. S. asks: I had always been under the impression that June 21st was the longest day in the year. But according to the almanac, there are several days around the period of the Summer Solstice on which the elapsed time between sunrise and sunset is virtually the same. To put the question in another way: Is there any one day in June on which the sun at noon attains its highest possible point in the heavens? A. The longest daytime, that is, the time from sunrise to sunset, is about June 21st, but varies a little from year to year. The Summer Solstice is the moment when the sun is exactly at its highest north of the equator. The Vernal Equinox is the moment when the center of the sun is on the equator as it crosses it going north. These times are measured by the astronomer to a hundredth of a second. At the moment of the Summer Solstice the sun is highest in the heavens in any northern place, or, as it is better expressed, farthest north of the equator. The length of daytime as given in an almanac which only gives the minute of sunrise and sunset, neglecting seconds, will not vary for several days at that season, but if you had seconds and hundredths of seconds, there would be but one day when the time from sunrise to sunset was the longest. Now, why does not this occur always on the same day of the year, say, June 21st? That is because the time from January 1st to June 21st is not the same from year to year, while the time from the Vernal Equinox to the Summer Solstice is always the same. Every fourth year we insert an extra day in February which puts June 21st a whole day farther off from January 1st than it was the year previous, and this changes the relation of the almanac time to the astronomical events which do not vary as the calendar does. The answer to your question then is: There is a moment in June when the sun is highest in the heavens but that moment does not always fall on the same day of the calendar, although it is always at the same distance in time from the Vernal Equinox. A good almanac should give you the moment of the Vernal Equinox and of the Summer Solstice. These are respectively the time of the beginning of Spring and Summer.

605
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Engineering

IN THIS ISSUE:

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# SCIENTIFIC AMERICAN

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SHIPBUILDING ON A SCALE OF INCHES: THE MODEL MAKER AT WORK.—[See page 38]

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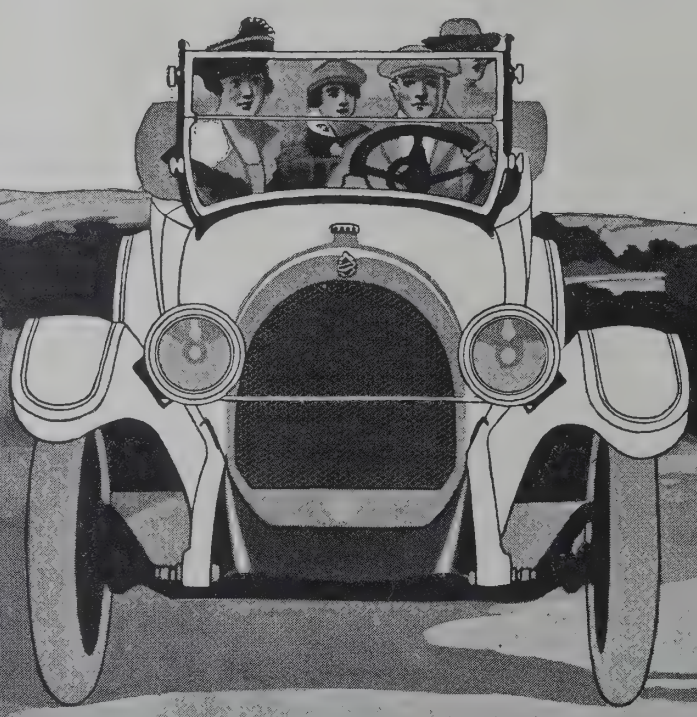

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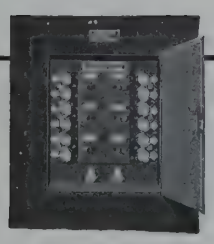

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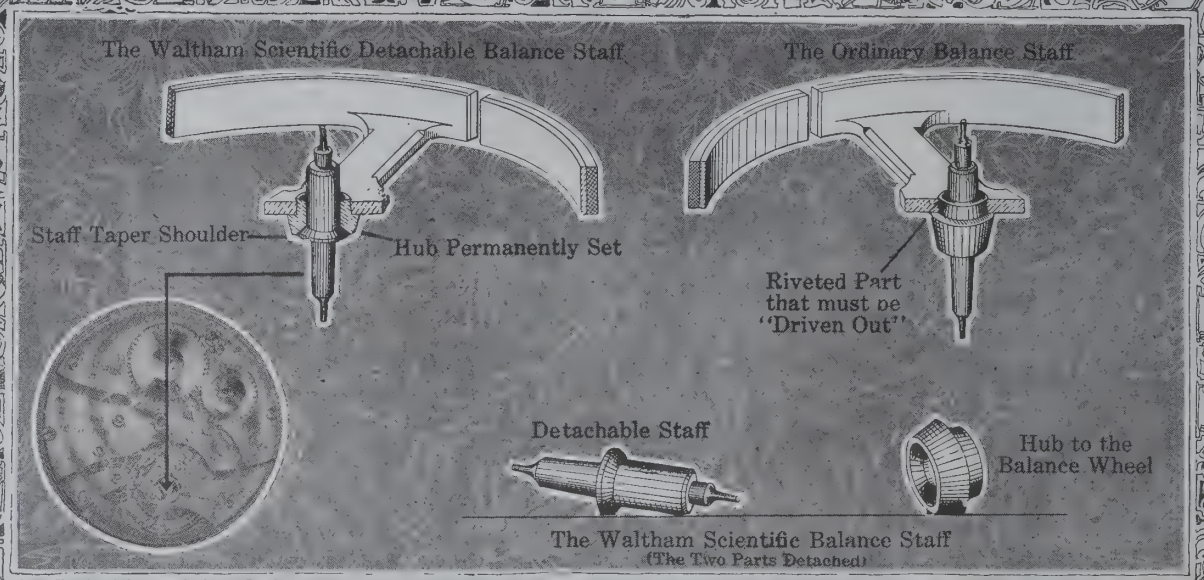


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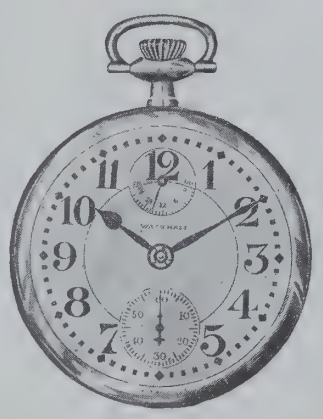

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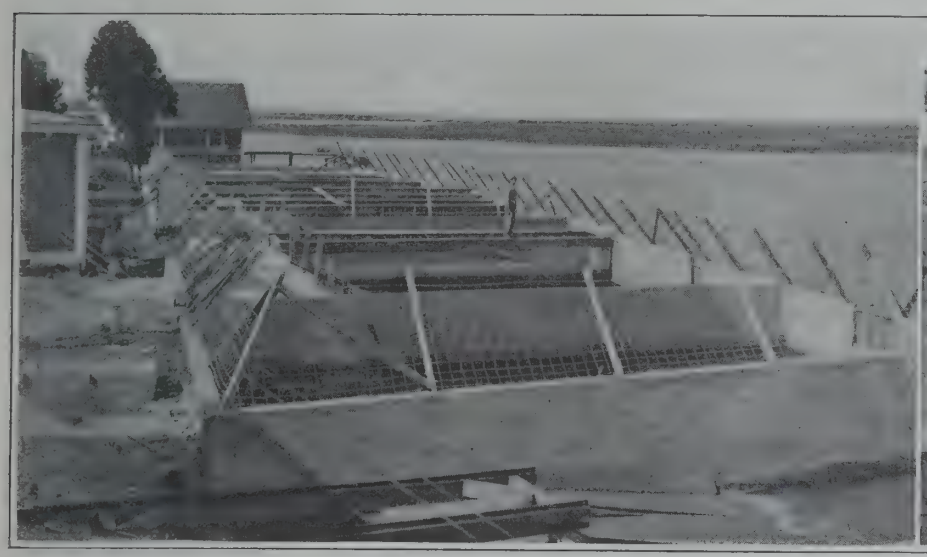

Pounds for the adult terrapin and a heated winter-house for the babies

Digging the baby turtles from the sand to put them in winter quarters

## Fish Fancying and Freak Farming

By George H. Dacy

ABILITY to appreciate and accept Opportunity when it presents itself often is the distinguishing attribute which centralizes the successes in one strata of society and the failures in another. Opportunity knocks at everyone's door at least once. The trouble is many of the residents are either not at home or else they are asleep when their chance for fame and fortune arrives. This is the simple story of a Southern townsman who did not need magnifying lenses in his glasses to see Opportunity when it came and who was on the front doorstep ready to welcome the honored guest.

About twenty years ago the Federal Bureau of Fisheries established an experiment station at Beaufort, North Carolina, and began investigations in terrapin raising under confinement. Naturally the townspeople were interested in Uncle Sam's freak fish farm. The doings of the scientists furnished plenty of food for local gossip while the fish ponds, the hatching beds and the winter-house for the young terrapin were interesting places to visit for recreation and amusement. Only one of the citizens, Dr. C. L. Duncan, apparently appreciated the commercial possibilities of domestic terrapin farming and he systematically set about to learn all he could about these aquatic turtles. For eleven years he studied the proposition and gained a first-hand knowledge of all the ins and outs of the fish-farming game. In 1913 he decided that he was equipped to embark in the business of raising terrapin on a commercial scale and as a consequence one of the most novel fish farms in the entire world has been established whereon at present more than 30,000 terrapin a year are being raised.

Years ago wild terrapin inhabited the salt and brackish marshes along the Atlantic seaboard in large numbers and were highly relished and prized by epicures. These palatable turtles have so grown in popularity that they now have come to be regarded as one of the greatest delicacies known to connoisseurs and the demand for them has led to such persistent overfishing that a marked diminution in the available supply has resulted. The result is that Chesapeake terrapin which measure six inches in length on the lower shell now sell for $50 to $60 per dozen on the city market while larger terrapin are correspondingly more valuable. Louisiana and Texas terrapin are almost as highly prized as are the Chesapeake variety while the Carolina and Florida species are not in demand for table use. The National Bureau of Fisheries has irrefutably demonstrated that terrapin farming may be practically and profitably engaged in on a commercial scale while the experiences of Dr. Duncan and a resident of Savannah, Georgia, who also has attempted this freak farming business, are staunch endorsements of the findings of Uncle Sam's fishing experts.

Doctor Duncan's fish farm covers about two acres of marshland close to the coast and is inclosed by a concrete and wooden wall and fence wherein the 2,000 odd adult terrapin can live comfortably, be fed and supplied with safe quarters for laying their eggs. Separate inclosures are provided for the young terrapin while winter quarters for the youngsters are provided in the way of an artificially heated house which is maintained at a temperature of 80 degrees Fahrenheit during cold weather when the turtles under natural conditions are accustomed to hibernate. Under natural conditions the young terrapin are hatched just about the time when the hibernation season is beginning. The consequence is that the young begin a long siesta as soon as they are able to waddle about. During their winter sleep, the baby turtles live on masses of egg yolk which are inclosed in their stomachs. They emerge from their mud holes the next spring much weaker, smaller and less vigorous than when they were born. On the other hand, the young which are housed in the heated quarters do not hibernate during the winter but feed voraciously and develop rapidly so that the following spring they are as large as two- or three-year-old terrapin which have developed out-of-doors. For commercial production of market terrapin, the hothouse method of forcing the turtles to early and economical maturity is most successful.

Terrapin mature and attain full development at the age of six to seven years. The males are only about two-thirds as large as the females and hence are less valuable for market purposes, selling for only $1 to $1.25 apiece. The mating is promiscuous, there usually being about twice as many females as males in the average colony. As a rule, it requires from eight to nine weeks for the eggs to hatch, the average female producing about fifteen young a year. Terrapin are notorious as being the worst mothers in the world as they abandon their young and never take any interest in the progeny after the eggs are laid. When ready to deposit her eggs, the female terrapin scoops a jug-shaped hole in the sand with her hind feet and therein buries her eggs. Then she replaces and packs the sand in place and as far as possible conceals the location of the egg nest. She then leaves the eggs to

Female terrapin six inches long and worth from $50 to $60; a male of smaller size and less value, as is usual; and a collection of eggs with the newly hatched young

(Continued on page 48)

# SCIENTIFIC AMERICAN

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*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## The $5,000 Einstein Essay Contest

IN January, 1909, an anonymous donor who was interested in the spread of correct scientific ideas offered through the SCIENTIFIC AMERICAN a prize of $500 for the best essay explaining, in simple non-technical language, that paradise of mathematicians and bugaboo of plain ordinary folk—the fourth dimension. Many essays were submitted in this competition, and in addition to that of the winner some twenty were adjudged worthy of ultimate publication. It was felt that the competition had added distinctly to the popular understanding of this significant subject; that it had done much to clear up popular misconception of just what the mathematician means when he talks of four or even more dimensions; and that it had therefore been as successful as it was unusual in character.

Today, after a lapse of eleven years, we have with us a freshly-risen scientific topic of transcendent importance—one which has occupied a place in the public prints and the public mind such as has never before been granted to any matter of abstruse scientific doctrine—and one which actually depends in large measure upon the very concept of extra-dimensionality which was so ably treated by the contestants for the prize of 1909. We refer, of course, to what for want of a better name must still be called the Einstein Theory of Relativity, but which possesses such universal bearings that it really cries out for a name less suggestive of controversy and narrow bounds. Every person of intelligence wants to know about this theory; and it is highly important that every person of intelligence know something about it. Numerous efforts have been made during the past six months to present it to the non-mathematician—some conspicuous failures, others successful in greater or less degree. By no means has the success of these efforts been in direct ratio with the distinguished position of the scientists making them. It is felt in all quarters that much remains to be done in this direction; and the SCIENTIFIC AMERICAN is of the opinion that a direct stimulus for further effort to make intelligible to the mass of educated people what Einstein has done is distinctly in order.

In view of the connection of the SCIENTIFIC AMERICAN with the previous prize contest, anticipating in more ways than one the event which we have now to announce, it gives us the greatest pleasure to state that Mr. Eugene Higgins, an American resident of Paris and for many years a close friend of this paper, offers through the SCIENTIFIC AMERICAN a prize of Five Thousand Dollars for the best essay on the Einstein postulates and their consequences, written so that a person of no special mathematical training may read it profitably. Mr. Higgins has followed in the footsteps of the anonymous donor of 1909 by leaving the entire contest in the hands of the SCIENTIFIC AMERICAN. He has deviated so widely from precedent in the amount of the prize with the purpose of attracting to the contest men of the very highest caliber, thereby making the event an unqualified success. This we are sure it will be. The sum of five thousand dollars exceeds, if we are not mistaken, any award open to a professional man with the single exception of the Nobel prize, for which he cannot specifically compete. The prize is very likely to exceed the annual salary of the winner, and is certain to amount to a very handsome proportion of that salary.

In order that prospective contestants may have every possible advantage of time in which to work up their material, we are announcing the contest at once, not waiting until the Committee of Judges shall have been selected. As in the contest of 1909, this committee will be a body outside our editorial staff, having no immediate connection with the SCIENTIFIC AMERICAN, so that they may be selected with sole reference to their eminent fitness to serve. It need not be pointed out that they will necessarily be men who will give up reasonably good prospects as contestants in order to contribute to the success of the event as judges.

The rules under which the contest will be conducted are displayed on the opposite page, and will be reprinted from time to time in later issues. It is earnestly hoped that Mr. Higgins' more-than-liberal offer will bring forth a more-than-liberal response, and that his intention of inspiring the writing of essays which shall really illuminate Dr. Einstein's system will be amply realized. We have tried to do our part toward this consummation by making the conditions as liberal as possible. We leave the issue in the hands of the competitors.

## The Water Power Bill

THE signing by the President of the water power bill is the first step toward the development of the abundant natural water power of the United States. It would not be easy to find a great national enterprise of a physical character, which has been made the subject of more painstaking consideration, and the bill as now signed represents the experience and considered judgment of some of the best minds in the country. Particularly gratifying is the fact that the law will harmonize hitherto conflicting elements; for while it carefully protects the interests of the people of the country at large, its terms are sufficiently liberal to attract the large amount of capital which will be necessary to render our natural water powers available for industry and commerce.

Under the new law, all water powers over which the United States Government has jurisdiction will be controlled by a Water Power Commission, composed of the Secretaries of War, Agriculture and the Interior. Licenses for the development of power will run for fifty years. The amount which the licensee must pay for the use of the water power is fixed by the Commission, and the price to be paid by the consumer is fixed jointly by the Commission and the State Commission, or, in cases where a local agency does not exist, by the Federal Commission.

When the license expires, the United States has the right to take over and operate the property upon the payment of an amount which shall not exceed the original cost. Licenses issued to private or corporate applicants will be subject to annual charges, fixed by the Commission for the following purposes: first, covering the cost of the administration of the Act; second, recompensing the United States for the use of its lands; third, absorbing any excess profits that may be earned by the licensees. One-half of the charges collected on account of public lands is to be paid into the Reclamation Fund, three-eighths to the States and one-eighth into the United States Treasury.

Of the charges collected on account of licenses on navigable rivers, one-half is to be reserved as a special fund to be spent by the Secretary of War in the maintenance of locks and for the construction of head-water improvements on navigable rivers. The remaining half is to be paid into the Treasury.

We recently dwelt in these columns upon the great economic advantages of the electrification of our railroad systems, a large proportion of whose freight consists of coal which is hauled for the operation of their steam locomotives. By removing the hindrances to water power development, the water power bill will prove a most active agent in bringing about the electrification of our railroads, to say nothing of a greatly increased substitution of central electric power stations, with long distance transmission, for many of the unrelated and widely scattered steampower plants, big and little, as they exist today.

## The Era of the Eighteen-Inch Gun

ALTHOUGH there is not as yet an 18-inch gun afloat in our Navy, there is reason to believe that already the adoption of the eighteen-inch gun is contemplated by the Bureau of Ordnance. If so, we shall probably have a renewal of the old controversy between the advocates of great volume as against great weight of fire, such as more than once has stirred up no little tempest on the calm waters of bureaucratic procedure and found an echo in the outside civilian world.

The contention that the discharge of a large volume of projectiles of moderate weight is more effective than that of a smaller number of much greater weight and power, is as old as the history of the rifled gun. The question was hotly debated when we moved up from the twelve-inch to the fourteen-inch gun, and again when we discarded the fourteen-inch for the sixteen-inch gun; and it is certain that, if the tests of the new naval eighteen-inch gun should be satisfactory, the question will once more be threshed out along the old lines.

If the eighteen-inch gun should be adopted, it will probably be placed on some of our new 43,000-ton battleships. As designed, they were to carry twelve 50-caliber sixteen-inch guns, which means that on the same displacement and with the same speed, fuel supplies and general accommodations, they will be able to mount only eight eighteen-inch guns, particularly if the new pieces are to be of 50-caliber length. Many people will be surprised that a reduction of fifty per cent in the number of guns should be necessary when the caliber is increased only about twelve per cent, but this is because the weights of guns and projectiles increase approximately as the cube of the diameter. This applies not merely to the rifle itself, but it affects also the weight of the mount and the loading mechanism, the total weight of projectiles in the magazines, and so forth.

In favor of an eighteen-inch gun are the following points: The gun is more accurate; its range and energy are much greater; the bursting charge also is greatly increased, and therefore the destructive effect, when penetration of armor has been effected, is far greater.

The disadvantages are that not only is the number of shells delivered in a single salvo thirty per cent less for the eight-gun battery, but because of the greater weight both of gun and ammunition, the rate of fire is slowed down, so that the total number of projectiles delivered in a given time against the enemy is considerably over thirty per cent less than that delivered from the twelve-gun ship.

Now, bearing in mind the common saying aboard ship that it is the shells which hit that count, it can be seen that there is over a fifty per cent better chance of landing on the enemy with a twelve-gun "Indiana" than there would be with an eight-gun "Massachusetts." The sixteen-inch shell weighs 2,100 pounds, and if we aim at the highest velocities and make our eighteen-inch gun fifty calibers in length, the weight of its projectile will probably be about 3,000 pounds, a fifty per cent increase in weight which must necessarily slow down the speed of handling. The only eighteen-inch gun afloat is the big fellow which the British built for the 32-knot cruiser "Furious," but subsequently mounted on a monitor and used in the bombardment of Zeebrugge. With a view to extending the life of the gun, the British used a heavy projectile weighing 3,600 pounds and having a moderate velocity.

Despatches from Washington state that 18-inch guns are to be used on two of the new battle-cruisers. If so, one turret and a pair of guns would have to be dropped, leaving these ships with six eighteen-inch guns in two-gun turrets, which would be an arrangement similar to that on the battle-cruisers "Repulse" and "Renown," which mount six fifteen-inch guns in three turrets.

If the eighteen-inch gun is to be adopted because of its superior range, it will be possible to utilize it at the longest ranges only in combination with airplane spotting and to make sure of spotting from a point above the enemy's ships, it is necessary that the attacking ship be accompanied by a fleet of fighting machines, sufficiently powerful to insure absolute superiority in the air.

## Electricity

**An Electric Atomizer.**—There has recently been placed on the market an electric atomizer which is suitable for use in hospitals, schools, sickrooms, and in a variety of other places. It is suitable for sweetening cellars or ice boxes when formaldehyde is added to the water in the atomizer. The atomizer consists of a small brass bowl which contains a heating element imbedded in insulating material. The apparatus is mounted on a wooden base and is supplied with a cord and suitable attachment plug. In use, the bowl is filled with water and a few drops of perfume or disinfectant are added as desired. The boiling of the water drives off the liquid in the form of vapor, thus humidifying, perfuming or disinfecting the room.

**Hydroelectric Development in Texas.** — More than $4,000,000 is to be expended in the construction of a hydroelectric plant which is under way near Eastland, Texas. Preliminary work upon the project is well advanced. It consists of the construction of a dam across the Leon River about four miles south of Eastland which, when finished, will impound more than 600,000,000 gallons of water and serve as the source of the initial power for generating electricity that is to be distributed throughout that part of Texas by means of transmission lines. One of the chief purposes of the company building this power plant is to furnish electric power for drilling and pumping oil wells in the Central-West Texas fields. It will also provide industries and towns with electrical energy.

**Long Distance Transmission Lines.**—According to a French engineer writing in *Revue generale de l'Electricité*, distances of 400 to 500 miles can be spanned with a transmission line by making use of the so-called "quarter-wave" construction. Such a line has the usual two conductors for single phase and three for three-phase, but frequency, capacity and inductance have such values that at no load the line is in resonance. The current must be maintained nearly constant at the generating end, and constant voltage will be received at the other, with reasonable regulation, efficiency and conductor cost.

**A Rotating Arc Lamp.**—A French inventor has recently worked out a rotating arc lamp in order to approximate as closely as possible the theoretical point source of light, fully utilized and automatically maintained. His arc lamp uses a cored carbon rod of much the ordinary type as positive electrode, which provides the luminous crater. The non-luminous negative electrode is a metallic ring surrounding and presenting its inner edge toward the crater; the ring is cooled by circulating water or spirit. By the action of the magnetic field of a coil the arc between the crater and the inner edge of the ring is caused to rotate at 500 to 3,000 revolutions per minute. The rotation is too rapid to be distinguished by the eye, and the arc only appears as a highly incandescent spot surrounded by a bluish halo. Only the positive electrode burns away and need be moved; this regulation is controlled by the dilation of a metal strip, and is independent of the arc current and voltage.

**French World-Wide Radio Scheme.**—There is being discussed in France a scheme for embracing the whole globe with stations erected wholly on French territory. To overcome difficulties due to atmospherics, experts believe that it will be necessary to use at least 1,500 kilowatts and to employ antennæ at least 1,500 feet in height. The network of stations proposed would comprise the stations at Tahiti, New Caledonia, Indo-China, Djibouti, and France. The center of the net work is in France, and comprises three stations able to communicate respectively with (1) the United States, (2) Martinique and Brazil, (3) West Africa.

## Science

**The British Association for the Advancement of Science** will hold its next meeting at Cardiff on August 24-28 next, under the presidency of Prof. W. A. Herdman, of Liverpool University. The inaugural address of the president will comprise a general survey of oceanography and a detailed discussion of certain problems, especially relating to sea fisheries.

**U. S. Government Maps.**—At a conference held in Washington last September by representatives of fourteen map-making organizations of the Federal Government and ten national scientific and engineering societies, several recommendations were made concerning future work of this character by the Government. It is proposed to appoint a permanent Board of Surveys and Maps to act as an advisory body, and to establish a central information office concerning mapping, preferably in the Geological Survey. Several other suggestions were made looking to coördination of work, but the conference reached the conclusion "that there is little actual duplication of effort materially affecting the progress of mapping the United States." It is estimated that the work of primary control, which is in the hands of the Coast and Geodetic Survey, can be completed by 1933 at a cost of $6,305,000, and that the topographic map, which is in charge of the Geological Survey, can be completed within the same period for $40,490,000 (including coöperative appropriations by states).

**The Latest Bull.**—That a little knowledge is a dangerous thing is made again clear by a reporter for a New York daily who was given the assignment of writing a couple of columns about Einstein, when this topic was still new, back in December. The bright young man went along swimmingly for a while, giving a very intelligible account of the predicted deviation of light passing near the sun, and the manner of making observations for this deviation during total eclipse. Then he went on to state that the Einstein doctrine was remarkably borne out, since not alone was the expected deviation observed, but Einstein was found to have accurately predicted its *time*—1¾ seconds!

## CONDITIONS FOR THE $5,000 PRIZE ESSAY CONTEST

1. No essay shall be longer than 3,000 words.

2. All essays must be in English, and written as simply, lucidly and non-technically as possible.

3. Each essay must be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted; but the right is reserved to divide the prize between two contestants if in the opinion of the judges the best two essays are of equal merit.

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The number and personnel of the Committee of Judges will be announced in an early issue.

## Aeronautics

**For Our Aviation Service.**—Appropriation of $60,000,000 for army aviation in 1921 has been recommended to the House Military Committee by Major-General Charles T. Menoher, Director of Air Service, $23,714,000 to be used for production and purchase of airplanes and $750,000 for balloons, airships and lighter-than-air machines in general.

**Aerial Licenses.**—The proper licensing of craft and pilots and airdromes is the first essential and has been adopted in all the allied countries, so there will be plenty of sound precedent to work upon. Legislation making illegal low flying and stunting and the dropping of advertising pamphlets must be put through without delay. Rules of the air roads, of entry and exit from airdromes, of lighting, et cetera, must also come up for consideration. The international air laws laid down at the Paris convention are practically drawn from the flying laws originally made for Great Britain and which were adopted by the nations who signed the agreement. American air conditions differ very slightly from those of other countries, and the international model will be found very comprehensive.

**Ford's Aviation Activities.** — The news that the Ford Motor Company proposes to build airplanes is not startling. It has been announced many times. But the powers of the new Ford Company permit it to manufacture aircraft. In this connection, it is perhaps worth mentioning that the Ford Company recently purchased in England the entire outfit and works of one of the largest airplane producers in Great Britain. The airplane has not yet reached that state of scientific perfection which permits of its being automatically thrown together by the mass production method. If, on the other hand, Mr. Ford were able to produce an all-metal plane for, let us say, $1,250 and produce them in large numbers scientifically, the boom in aerial "flivvers" would probably be great. However, with the force at his command and the interests he controls, Mr. Ford would be doing a real service to humanity in general, and to America in particular if he were able to produce rigid airships by mass production.

**Why Not Fireproof Tanks?**—Is it not time that all aircraft were fitted with fireproof gasoline tanks in this country? Would it not be rendering the greatest possible service to aviation to insist upon their use? Our air authorities appear to be strangely blind to the fact that if you want public money for promotion of flying, it is necessary to obtain public belief and confidence in the resources of the air. In flying, as in all other forms of transport, fire is the most terrible risk. It very rarely occurs except in a crash or a bad landing. If the gasoline tank is of the ordinary kind that bursts upon hitting the ground, fire is almost certain. But the air authorities know that there are fireproof tanks which have proved sound after most exhaustive tests—so much so that practically all British machines were fitted with them at the close of hostilities. All civil machines should be fitted with them at once.

**A Flying Academy.**—When the American flying service really gets into going order, serious consideration will have to be given to the establishment of an academy similar in type and standing to the military and naval colleges at West Point and at Annapolis. Since it is certain that in a few years' time the flying service will be of equal importance if not of more importance than the other services, an air college from which men may be commissioned direct into the service after strenuous tests will become a necessity. The practical interest already taken in aviation by the big educational institutions promises well for the future.

# The Twentieth-Century Lumber-Jack

## Some of the Machines and Methods Which Were Not at the Disposal of His Grandfather

By J. F. Springer

*LUMBER! That is the question of the hour—and a grave one. For decades these United States enjoyed the finest and most expansive forests to be found in any part of the world; and that very abundance made us careless with regard to our lumber industry. We kept on cutting trees with little thought about the future. Our reforestation plans were on too small a scale. And the inevitable has come to pass: we are facing an early lumber famine, unless drastic measures are put into execution at once. This article deals with the improved methods of logging. Another article will deal with the lumber shortage. Still others will appear from time to time bearing on the lumber industry.*—THE EDITOR.

LOGGING is, naturally, one of the old lines of activity. It is also one of the highly modern ones. Its procedure has undergone various changes, so that the practice followed at present in certain leading centers of activity would probably astonish the old experts if they could now view the happenings from beginning to end. These old fellows would doubtless be gratified to learn that with all the great advances in machinery two of the oldest of all hand-tools are still leading devices in the lumberman's art. These are the wedge and the axe. The cross-cut saw has taken over some of the duties of the axe, but the latter tool is still indispensable. Trees are felled with the axe alone, or with the axe and the cross-cut saw, the wedge being employed as an auxiliary. It will perhaps surprise many to learn that there has apparently been invented no power-driven machine for felling trees that has secured any widespread commercial application in logging. Probably the difficulty in designing such a machine centers not so much upon making it successful in the actual felling as in the matter of easy portability. The tree may stand in the midst of brush and undergrowth, or upon uneven ground or far distant from a considerable road, and in consequence be difficult of access for a mechanical device and for the power unit to drive it. The axe, wedge and cross-cut saw can go wherever the men can go, and this is one great reason, no doubt, for their continued popularity.

A good deal of change has come over modern logging in connection with getting the logs from the place where the trees are felled to the principal avenues by which they are transported to the mill. Here the cable-way has come into large use. Instead of dragging or sliding the logs along on skidways or the like, they are hoisted into the air and carried along clear of brush, old logs and uneven topography. But while cable-ways have invaded a part of the transportation field, this is not to be understood as meaning that the older procedures have been altogether displaced. By no means. There are situations, and many of them, where the cable-way is not so easy to install and others where it could hardly be installed at all.

As to transportation to the mill, the waterway is still employed; but in Michigan, Washington, the South and elsewhere, there are numerous logging areas where there is no adequate and convenient stream. New England conditions do not, by any means, generally obtain in the logging regions of the United States. The logging railroad is now in considerable evidence. Then with the development of the motor tractor, this device has come into use. In short, there are many situations now where instead of the logs being rafted and floated individually along, they are being hauled in trains, either by locomotives and tractors or else by mules, horses or oxen.

**A typical lumbering scene from Washington, with donkey engine and cableways**

The felling of any tree is an interesting operation. This is pre-eminently the case when the tree happens to be a giant of the Pacific coast—a big sugar-wood, spruce, Douglas fir or redwood. A great notch is made on the side of the tree selected as looking more or less directly in the direction desired for the fall. It is placed a little above the swelling due to the roots. This notch may be wedge-shaped, with the two surfaces at an angle of about 45 degrees and the under surface horizontal. The notch has two possible functions. One is to direct the fall and the other is to prevent bad splitting of the bole. Sometimes the tree naturally leans in the direction of fall. But at other times this is not at all the case. A smaller notch than the size ordinarily used is then employed (unless the axe is to finish the job), contrary to what one might expect. The reason centers on the use of wedges. These are used with more effect, it seems, when the notch is comparatively small. The actual felling of the tree is effected from the side opposite to the notch. Where the old method of doing the felling with the axe is to be employed, the notch on the opposite side is to anticipate this use and to be made very deep in consequence. In fact the cuts penetrate past the center of the hole. Here is a marked distinction between the older and the newer practises. With the latter, the felling is done with the cross-cut saw and wedges. The notch on the side on which the tree is to fall is greatly reduced in depth, the penetration being often less than half a radius. This means a very great reduction in the amount of wood that has to be removed from the notch. On the opposite side all the work is done by the axe and the wedges. Work with the axe is, for the whole job, enormously cut down as compared with felling by the axe. Even in the matter of the notch the horizontal cut may be made with the cross-cut saw, the axe being used for the slanting cut only. While the inclined cut is ordinarily made above the horizontal one, this is not at all necessary. Thus, it may be very desirable to save as much of the bole as possible. Under this condition the slanting cut with the axe may be made underneath. The reader who has carefully followed the foregoing will have no trouble, perhaps, in seeing that the axe is coming to take only a small part in the cutting down of the great trees of the forest. Its duty may be confined only to a slanting cut reaching in less than half a radius.

Assuming that a small notch has been made with a view to felling by saw and wedge, the saw is started on the opposite side of the bole a few inches higher up than the horizontal surface of the notch. The saw is operated horizontally. After a while it will have completely buried itself. As it goes on into the body of the bole, wedges will after a little become usable.

(*Continued on page 48*)

1. A donkey engine loading spruce logs on to flat cars, using a "gin pole." 2. The butt end of a good-sized spruce immediately after felling. 3. Tractor taking out a big log.

**Lumbering with modern machinery in American forests—forests which will have to be carefully conserved from now on to avoid a lumber famine**

1. The old familiar navy-type anchor is still being made, chiefly for pleasure yachts and sailing vessels. 2. The "dropping test" on the head of the modern stockless anchor. 3. The modern stockless anchor. 4. Testing the anchor on land to determine its behavior on the ocean bottom

**Old and new types of anchors and how they are tested to determine their fitness for sea duty**

## Is the Anchor Safe?

**By Paul Harnden**

THE ship's anchor, from the standpoint of safety, is a very important piece of equipment. Before an anchor is accepted for any of our great sea-going vessels it must pass severe tests and a rigid examination both by the manufacturer and by Lloyd's and the American Bureau of Shipping.

Since most of our anchors are of cast steel, the designer must be careful that all junctions of metal are of uniform thickness, to avoid cooling strains in the metal. The modern stockless anchor consists of only two principal parts, a shank and a head. The head is movable on the shank and has two wide spoon-shaped flukes, which are depended upon for gripping power. Since the head must bear most of the strain it is most thoroughly tested.

After the head has been cast and annealed it is given a "dropping test." It is lifted about ten feet above the ground by a crane and dropped on two solid pieces of iron. This is to guard against fracture when the anchor is dropped to the bottom at sea. It sometimes happens that the anchor is broken in two when it is dropped on "hard" or rock bottom. All parts of the anchor are carefully inspected before assembly, even to the pins which lock the parts together. After complete assembly the anchor is given a final "pulling test." In this test the flukes are dropped into a depression in the floor, a chain is attached and a hydraulic machine delivers a measured pull several times greater than the anchor will ever have to resist in actual use. If the anchor is found flawless after this test it is passed, ready for use at sea.

Manufacturers have devised other tests for their products, some of which are even more severe. One test, by which it was attempted to show just how the anchor acts on the sea bottom, is shown here.

The assembled anchor was dropped a distance of twenty feet onto hard slag and then was dragged along frozen ground (hard bottom) for a distance of twenty-five feet. Here the flukes found a soft spot and "dug in," with the result that continued power applied by the pulling engine caused the anchor to lift bodily between four and five tons of frozen earth.

The largest "stock anchor" made is the 10,000 pound size, shown in the photograph. The largest vessels, however, require anchors three times this size, and these must be "made to order."

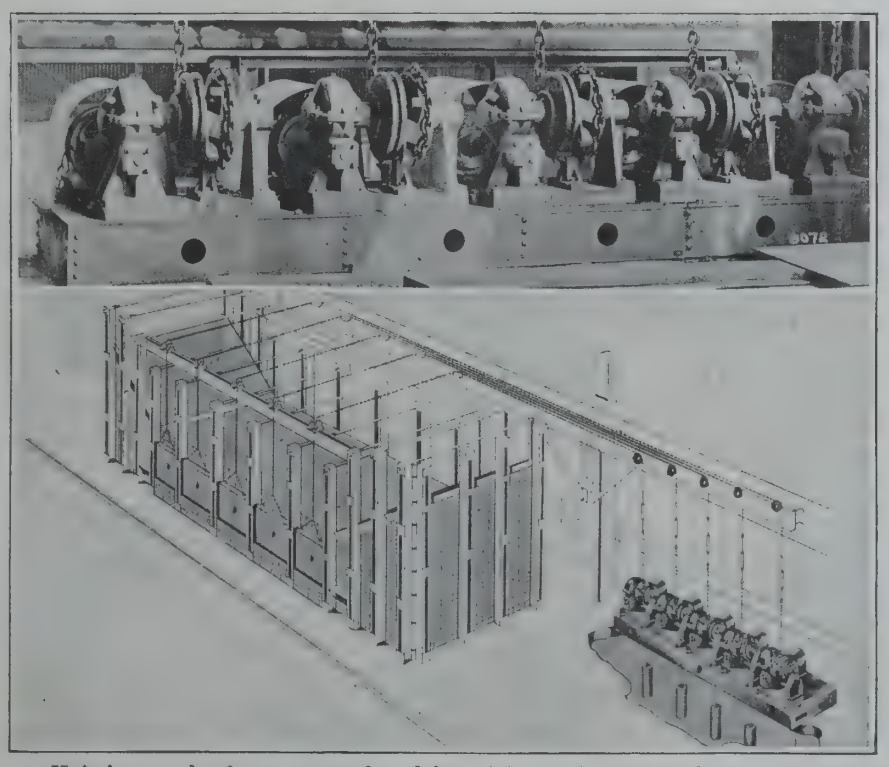
It is interesting to note that the old familiar navy-type of anchor is still being made. It is used chiefly on pleasure yachts and sailing vessels, where it adds a picturesque touch.

The manufacture of anchor chain is of no less importance than the making of the anchor, because the anchor would be worthless without a good chain. Until the last two years all anchor chain was forged and it was considered impossible to cast it successfully. Difficulties of manufacture have been overcome, however, and a large part of the anchor chain used on our new merchant marine is of cast steel. Its makers subject this chain to a more severe test than is required of forged chain and it is claimed the cast chain is much stronger. The chain is subject to a pulling test, as is the anchor before final acceptance.

## Electrification in Europe

THE electrification of the German-Austrian West Railroad, according to the statement of the Under-Secretary of State, Dr. Ellenbogen, will be possible in about three years. This will mean a saving of about three million tons of coal. The stretch in Voralberg will derive power from the Lüna Sea, while that from Wörgl to Arlberg will be fed with electricity generated in the Achen Sea; the improvement of electrical stations in Salzburg and Karpun will furnish power for the section from Salzburg to Wörgl and Salzburg to Linz; that from Linz to Vienna will receive electricity through the harnessing of several different sources of water power.

There has been created in Warsaw, to study the electrification of the main railroads in Poland, a commission whose duty it shall be to collect data concerning present steam locomotives in Poland, electric railroads and larger electrical undertakings in foreign countries, data concerning the advantages arising from electric railroads, under what conditions they work and the reason for their introduction. The commission shall render an opinion, on the basis of this material, whether and to how great an extent the railroads of Poland should be electrified.



**Hoisting mechanism now employed for raising and lowering doors of open hearth and heating furnaces**

## Handling the Heating-Furnace Doors

**By Jules Gaudel**

DEVELOPMENT of a fool-proof automatic system for raising and lowering heavy doors on open hearth and heating furnace work has been recently announced by a large machinery firm of Chicago, after the first installation in a steel plant in Conshohocken, Pa., which has been in continuous operation for fourteen months. Doors operated by this method, it has been demonstrated, always go up to the proper position, and always go down to the proper position, no matter what their weight may be.

Five hoists with an automatic release are used. On each hoist is mounted a pair of chain sheaves, attached to a worm wheel shaft between two flanges, which are pinned to the shaft and supplied with fiber friction surfaces on the sides toward the sheaves. The worm wheel is driven by a worm mounted on the shaft of a reversible motor, the worm and wheel being enclosed in suitable housing.

To raise the furnace door the motor is started in the direction which will pull down on the left-hand chain. As long as the counterweight continues its pull, the sheaves squeeze out against the flanges, and are thereby driven in the direction which will wind up the left-hand chain, and thus lift the door.

The right-hand sheave has a fixed stop on its periphery, so located that it will come in contact with a stop on the bottom casting when the furnace door has reached its proper height. With the motion of the right-hand sheave arrested by this stop, the shaft cannot rotate the left-hand sheave farther because the squeeze between the sheaves and friction flanges are relieved. There is no opportunity, therefore, for overwinding, and if through carelessness the current is not shut off promptly, the shaft with its flanges will simply continue to revolve in a sliding frictional contact with the sheaves, but without the power to grip and rotate them further.

For lowering the doors the direction of the motor is reversed, and practically the same process repeated, except that in this case the power of the motor is used to lift the counterweight, while the pull from the weight of the door serves to keep the sheaves squeezed apart against the friction flanges until a stop on the left-hand sheave engages with a stop in the bottom casting, and prevents overwinding of the counterweight chain in the same manner as described above for the other sheave.

The stop features do away with the automatic electric switch devices which have proved so troublesome for this type of hoist, as well as for skip hoists; and they secure an exact stop for all such hoists without involving failure from human carelessness or complicated electrical equipment. Simple push button mechanism controls the device. The battery of hoisting motors as well as the arrangement of the equipment is shown in the accompanying illustration.

# Turning the Wheels of a Century Hence—II

## Water Power—Some of the A-B-C's That Govern Its Existence and Development

By C. H. Claudy

IT is true that any flow of water is a manifestation of power and that could we utilize that power our power troubles would disappear. But there are certain natural laws and certain economic laws which prevent our doing so. To make this the plainer, consider one of the fundamental theories of water power, which is that there is a fixed relation between "head" (which means briefly, the height from which the water falls) and the quantity of water falling. To develop the same power, the greater the height the less the quantity need be—to develop the same power the less the height the greater the quantity must be. In theory then, if we had a very large river with a practically infinite flow, we could get all the power we wanted out of a one-foot fall by using a great many small wheels, each of which would be moved by the small power of so small a fall. Practically, we can do nothing of the kind, as the installation would be too tremendously expensive and the maintenance too great.

Mere flow of a river, then, does not indicate a power source which is available. To make that power available, we must have a fall of sufficient height to turn, economically, a wheel which will give out power which is not more expensive than the same installation and upkeep would procure through the use of fuel.

There are certain locations where this condition occurs naturally and many others where it can be created artificially. But by no means all natural locations are economic locations, because of the fact that they are not near enough to the market for power. One of the greatest water powers in the world is in Africa, but it is as useful to us as the ice at the North Pole is useful to the icemen: we can't make it available because we can't transport it.

Power is not a *thing*, which can be made, packed, stored and used in the future. With a few exceptions, it must be used when made and largely where it is made. Electricity, of course, can be transported (the phrase is inept, but carries out the simile) by a suitable installation of conduits—electricity brought into being and under control at a power-dam site can be made available to do work economically up to a distance of two hundred and fifty miles, sometimes a little further away.

A curious limitation to the "transportation" of electric power is found in the cost of copper. Copper is the only metal we have of sufficient strength, and sufficient ability to "conduct" electricity, to enable us to use it as a long power line. Copper is costly. The farther away the source of electricity, the greater the voltage must be to force the current through the long line. The greater the voltage the better must be the insulation if the current is not to leak away. So a very long line means a very costly installation. Moreover, the longer the line the greater the drop in potential, and there comes a point where the difference between power developed and power delivered is greater than the economy of water power over coal power. Hence the geographical location of natural sites is a limiting factor to the economic possibilities.

The schoolboy is frequently amazed at the fact that large rivers so frequently flow near big cities. His elders say truly that if the natural power-site is too far from industry, industry may move. And industry has moved, and will continue to move to points where it can get power. It seems unquestionable to many minds that the great economic development of the future lies on the western, rather than the eastern coast of this country because it is the western coast which has the greater water-power possibilities and because coal exhaustion will naturally send power users where the power is. This, of course, is predicated upon the thought that we never are to learn how to "transport" power long distances or how to "store" it.

By no means all natural falls are economic from a development standpoint. There is a limitation in nature which is of the greatest concern to water power development engineers. This limitation is concerned with the flow of the water—its maximum and its minimum. We have learned how to take care of flood water, and we know how to provide against the time of little water; but it is one thing to know how to do a thing and quite another to do it.

Let us suppose a river with a great water-fall, let us say of a hundred feet. During ten months of the year the water coming over is sufficient for the power being developed. During two months the natural flow is diminished to such an extent that artificial storage must make up the deficit. This situation the engineer meets by the creation of a storage lake of sufficient size to hold enough water to keep the power-flow constant during the slack months.

Now let us suppose another river with a fall of twenty feet. Roughly, there must be five wheels on this falls to develop the same power which one wheel develops with the greater fall. If this river is slack for two months its storage reservoir must be five times as large as that of the smaller river with the greater fall. But a lake five times that size may be utterly impossible of construction in the basin behind the falls.

To make this the plainer, consider the Great Falls of the Potomac eighteen miles north of Washington, D. C. Here is unquestionably a great water power going to waste, which could develop in times of normal flow more than enough power to light the streets and the homes of the capital city, run its plants and its elevators, turn its wheels and propel its street cars. But the Potomac comes down through a narrow gorge or rocky valley. There is no place available to make a lake of sufficient size to hold water enough to tide over such a plant at times of slack water. The variation between the normal flow and the low water is very large, and between flood water and low water enormous. A plant calculated upon normal flow would require a storage reservoir much larger than the terrain makes possible. Therefore, to make a power development at Great Falls a practical matter, a steam plant would have to be installed to take up the load when the water power failed. This expedient is very common, but of course means increased expense, a large overhead and maintenance, a coal pile constantly on hand, additional insurance, increased labor, all of which factors enter into the cost of the water power.

There is a great and fundamental difference between a factory producing power and a factory producing baby carriages or refrigerators or machine tools or locomotives or pianos. There is a fluctuating demand for manufactured commodities. In the case of refrigerators, for instance, spring and summer see a demand, fall and winter a falling off in demand. If the factory was built to the size of the spring and summer demand it would be too large in fall and winter. If built to the size of fall and winter demand it would be too small for the spring and summer demand. So it is built with a capacity between the two. In fall and winter it makes more refrigerators than it can sell, in spring and summer it makes less than it can sell. The cold weather surplus becomes the balance wheel against the warm-weather demand.

But a factory for power has a demand which fluctuates not by seasons but by hours, and has no way of storing its power production during the minimum load hours. It must, then, be built to supply its greatest demand, and always have idle units during times of lesser demand. This increases the cost in two ways: in the first place by the extra investment, which part of the time does not earn dividends; and second, by the deterioration as well as the running expense of the plant not engaged in producing power which is sold.

These expenses are less in the case of water power than steam power, for this reason: an idle water-power plant (idle during a part of the day) means no fuel expense. An idle steam-plant must still keep up steam in boilers, and while fires may be banked and some coal saved, nevertheless steam pressure and heat must be wasted if the load is to be picked up promptly when it occurs during the next peak-load hour. Again, therefore, those low heads which require steam plants as aids in time of low water, are much less economical developments of "white coal" than are the high-head streams where the water storage can be sufficient to take care of seasonal fluctuations of water supply.

All these considerations have been put forward that there may be a real understanding of the great difficulty of making any genuine estimate of the maximum possible water-power development in the United States. There are those proponents of water-power development who contend that the amount of undeveloped water power within our borders is far greater than engineers will admit. And from the standpoint of possibility they are perhaps right. But when an engineer estimates undeveloped water power he does not consider the possibilities but the economic probabilities. Such an engineer would doubtless call the Great Falls of the Potomac an undeveloped water power, but would not call "Little Falls" close to the city a water power at all. True, it *could* be made into a dam and supply power, but the head would be so small, the storage practically so little, that it wouldn't be nearly so economical as burning anthracite, let alone bituminous coal.

Remembering that distance from available market, difference between high and low water, differences in demand, amount of head and possibility of storage all limit the practical development of a flowing stream into a power station, consider some statistics which have been gathered regarding water power in this country.

The Geological Survey estimates, as of January, 1920, that there is produced in the United States an average of 1,200,000,000 kilowatt hours of electricity by water power and an average of 1,800,000,000 kilowatt hours of electricity by fuel. Of the total amount of electric power produced, therefore, about forty per cent is water power and the balance fuel power. These figures are for consumption in public utilities, and do not include power for manufacturing or in private plants for light and power otherwise used.

The available horse-power which *could* be developed by the use of water has been estimated at nearly twenty-eight million as a minimum and about fifty-four million as a maximum. Such figures are not inclusive of any possibilities of storage by huge reservoirs but merely take into account the development of existing natural power, or the construction of economical artificial powers (dams for power or navigation purposes).

But as we have seen above, it is not feasible to set a maximum limit because no one knows what the possibilities may be when demand becomes acute. The maximum figure may be less and is probably more than that indicated. In making its calculations the Survey states that in determining the minimum horse-power the minimum flow for the lowest two consecutive seven-day periods in each year was determined, and the mean of these values for the period was taken as the minimum flow. The maximum was determined on the assumption that wheels may be installed up to an amount of flow that can be assured during six months of the year. The estimates assume power measured on the turbine shaft with 75 per cent wheel efficiency.

No estimates based on the possibilities of storage have ever been made which were in any way reliable. Of this problem the Commissioner of Corporations said in a report on water power, "The difficulties of estimating the possible power development of a stream multiplies when an attempt is made to estimate the supplemental reserve force that can be put into it by storage. Not even the authors of such estimates have yet ventured to publish them in detail; they have generally confined themselves to a total for

(*Continued on page 50*)

*THE first article of this series endeavored to make plain that, outside of the fuels, the only power resource which is available with present-day knowledge and present-day methods and present-day economic conditions is that of gravity, made manifest and useful through falling water. We have not yet found an economical way of harnessing tide-power, sun-power, earth heat, atmospheric electricity, earth rotation, atomic or molecular power. We have found methods of harnessing water power. But while the water-wheel is ancient and its development great, it does not necessarily follow that wherever there is falling water there is power. Some of the reasons for this statement, with a discussion of how we may tell where we have water power and how much water power we have, constitute Mr. Claudy's theme in the present discussion. In the final number of the series he will pass to a consideration of what we have to do to make this power available.*—THE EDITOR.

# Measuring Steam

## Methods and Instruments for Determining What the Power Plant Is Doing

By A. R. Surface

IT is only within a comparatively few years that engineers have interested themselves in the metering of steam, but the attention now devoted to the efficiency of operation of industrial plants has created a demand for apparatus which will provide definite information as to the quantity of steam flowing through a pipe. The question of steam measurement first came into prominence in connection with tests of steam-engine efficiency, and the general practise was to condense the steam and to measure or weigh the resulting water. The measurement of steam—as steam—is a different matter altogether, and a far more difficult one.

The most obvious field for steam measurement is when steam is sold to an outside purchaser, or supplied to some department of a factory which has to keep separate costs. The power-plant, as the producers, are not concerned with the efficiency with which such steam may be used, but have to be paid for what they supply. On the other hand, the consumers of steam may rightly demand that they should be charged for steam only and not for water of condensation entrained with the steam. Again, in these days of large boiler plants, the engineer in charge should know how much steam each boiler, or at least each battery of boilers, produces in order to have a check upon their evaporative efficiency as affected by the kind of coal burnt, the method of firing, or the condition of the boilers. Individual water-meters on the feed lines of each boiler, even when fitted as they very rarely are, do not adequately meet the case, for they register all water entering the boilers, including much that is not turned into steam at all. Moreover, the ordinary water-meter merely counts the number of pounds or gallons which have passed, and gives no indication of the rate of flow at any time. Hence there is an increasing tendency for the provision of steam-flow meters in boilerhouses where a high efficiency of operation is aimed at.

Numerous other cases in which the direct measurement of steam is desirable or necessary will at once occur to the mind. The steam supplied to gas producers, for example, must be measured as steam or not at all, and a large number of industrial or chemical processes use steam, the amount of which must be known by the management if the best results are to be obtained either from the process or from the steam generating plant.

Most practical steam meters are based upon one or other of two principles. Either there is a slight constriction inserted on the steam pipe so as to cause a small pressure difference on the two sides, which will vary with the amount of steam passing, or the velocity of the flowing steam is measured by a sort of Pitot tube. The actual measuring instrument can be placed at any convenient distance from the steam pipe and is connected to it by means of two small copper tubes filled with water of condensation which transmits the differential pressure to the instrument. The latter may be constructed either simply to indicate on a dial or scale the rate of flow of the steam at any instant, or to record the rate of flow graphically on a diagram, or to integrate numerically by means of a counting mechanism the quantity which has passed in any given time. Indeed all these functions can be combined in one instrument if desired.

Although the average steam meter at the present time can hardly be classed with instruments of the highest precision, it must be remembered that measurements of steam in ordinary industrial practise need be no finer than is possible in the case of coal or water. If what is called "commercial accuracy" can be obtained in the metering of steam it is as much as the ordinary engineer will demand. Given fairly steady conditions of pressure and superheat, and not too great a variation in the rate of flow, several types of meter will record the quantity of steam passing with an error of about 2 per cent, which is sufficiently accurate for most practical purposes. In the steam meters of continental design which are now on the market little attempt seems to have been made to compensate for the errors which must occur if there is any considerable variation in the steam. The principal British makers, however, employ an ingenious automatic correction for this error, and their meters are in consequence highly accurate over a considerable range of pressure. The same firm issue with their meters a table by which the readings may be corrected for the density error arising from variations in superheat, but no automatic correction for this error has yet been embodied in commercial instruments. It may be taken that the best steam meters working under commercial conditions will give results correct within plus or minus 2 per cent, at loads ranging from three-quarters to full load. At half load the accuracy will be within 2½ per cent, and from one-quarter load to one-sixth load it will be within 4 per cent. Such accuracy can be obtained only by calibrating each instrument under conditions similar to those under which it will have to work.

The mechanical methods adopted to translate the difference of pressure due to the flowing steam, whether determined by a constriction in the pipe or by a Pitot tube, into the actual readings of an instrument differ widely. The simplest instruments of all, those which merely indicate the rate of flow at an instant, sometimes do so by allowing the differential pressure to act upon liquid in one limb of a U-tube, thus causing the liquid to rise in the other limb and to indicate by its height the rate of flow, which is read off a suitably graduated scale placed alongside the liquid column. Water is sometimes used as the indicating liquid partly on account of the ease with which it is automatically supplied by condensation, and partly because of the open scale obtained with very small pressures. Mercury, however, is frequently adopted. For equal pressure-differences the height of the mercury column is only about one-thirteenth that of a water column, s

(*Continued on page 50*)

# Correspondence

**The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.**

### Science in Painless Doses

To the Editor of the SCIENTIFIC AMERICAN:

The recent communication from New Mexico containing some truly remarkable revelations concerning the solar system reminds me of a short article I read in the Sunday magazine section of one of the Pittsburgh papers some three months ago. This article, which unfortunately I did not preserve, was written as an authoritative explanation of some of the everyday scientific phenomena which we meet. Among other things it discussed the starting and stopping of a heavy train. It pointed out very nicely how both these operations require investment of energy, the one to negative the momentum of the moving train and the other to create such momentum. Of course, it said energy when it meant momentum, but we can pass that by to get at the main point. Having got this far, the author proceeded to explain, at some length, that it takes more energy to stop the train than it does to start it, because the amount of energy which it has by virtue of its motion after it gets going is greater than the amount of energy which it does not possess when standing still.

ROBERT B. DONWORTH.

Boston.

### About That "Power Famine"

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of April 17 is featured an article entitled "California's Power Famine." This has come to the notice of a large number of our membership, including the Committee on Manufacturing of the Chamber, who feel that this startling headline is very damaging and not in accordance with facts.

It is true that there is a water power shortage in the state. This is most severe in the north, less severe in the central part, while in the southern part of the state plenty of power for all purposes exists through the foresight of the city of Los Angeles in constructing its 250-mile aqueduct some eight years ago, the hydroelectric power house on this aqueduct and the completion next month of an additional power house.

The article in the SCIENTIFIC AMERICAN is of a tenor to halt all enterprise in this section dependent upon electric power. Unless there is enforced pooling of all power in the state, the southern part of which Los Angeles is the metropolis will be well able to meet all demands and make good our claim that we have plenty of power at reasonable rates.

Could you not put these facts before your readers in order that they may be familiar with the situation as it is?

LOS ANGELES CHAMBER OF COMMERCE.

### Cinder Concrete

To the Editor of the SCIENTIFIC AMERICAN:

On April 10th you published an article entitled "Carbon Concrete." I suggest that any move to use cinders in re-enforced concrete is very dangerous. I saw not a few floor slabs after the San Francisco fire where the steel in contact with the cinder concrete had almost entirely oxidized. I myself removed a large outside porch floor made of cinder concrete re-enforced with a heavy expanded mesh, the spans being about eight feet between I-beams and the expanded metal and the top of the I-beams as well was almost entirely eaten away; and it is a wonder there had not been serious accidents.

I also removed a re-enforced concrete wall where the sand used had been sweepings containing a small portion of hard wall plaster or sulfate of lime; the ¾-inch twisted rods had entirely oxidized in less than four years.

No aggregate should be used in re-enforced concrete where there is even a suspicion of sulfur or sugar.

As a matter of interest, in 1907 I rebuilt an old warehouse. The twisted steel rods in the foundation located at about high tide level had been in the wall twenty years. They were in perfect condition, with not even a speck of rust upon them, although they had been alternately wet and dry daily for twenty years. Originally twisted but once in twenty diameters, I retisted the rods to once in ten diameters, had them tested and re-used in new work. But keep cinders away from concrete where steel is used.

Los Angeles. CHAS. E. RICHARDSON.

### Maternal Impressions

To the Editor of the SCIENTIFIC AMERICAN:

In reference to your science note on "Maternal Impressions in Canaries:" A friend of mine has told me of a man he knows who lives near a railroad at a spot where the engines always whistle. He told my friend that he had never been able to raise chickens there as they were always deformed when hatched and died shortly afterward. This man wanted my friend to hatch some eggs for him and told him of the circumstances and if it were not that I had told my friend about the canaries he would have told him he didn't know what he was talking about.

I have suggested an experiment which would be interesting and that is to exchange eggs and hatch them. They would then know whether the damage was done when the egg was forming or when it was being hatched.

Maybe you could tell me whether this has already been tried.

LEONARD W. SMITH.

Newark, N. J.

[*We do not know of any such experiment that has ever been carried out. Perhaps some reader does, or will be provoked by Mr. Smith's letter into trying it.*—THE EDITOR.]

### Not Yet Time to Scrap the Switch Engine

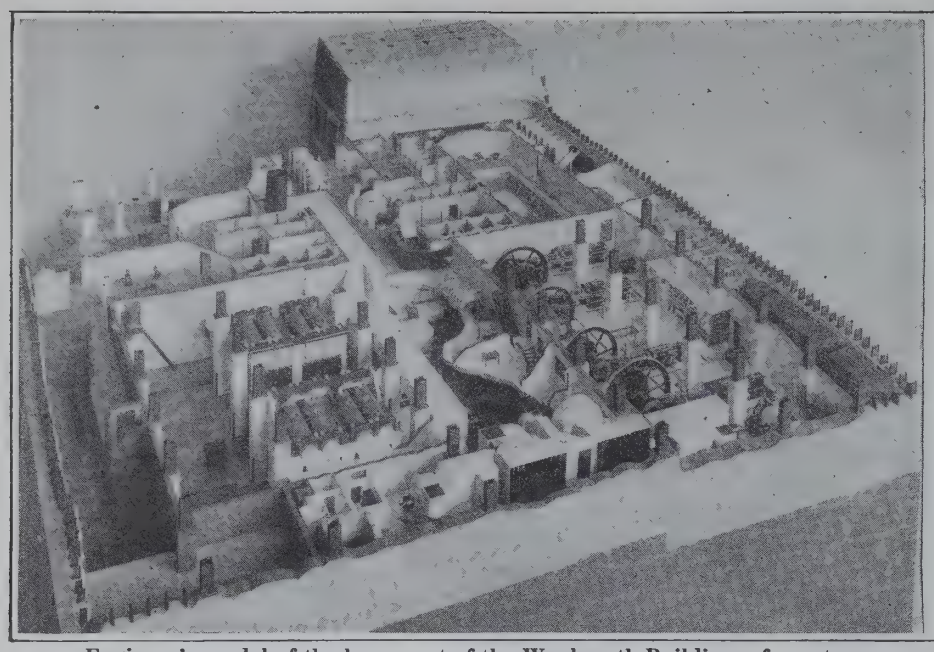
To the Editor of the SCIENTIFIC AMERICAN:

In connection with your recent article, "Getting Along Without the Switching Locomotive," I would make a suggestion. All indications are that sooner or later the railroads will be electrified, and when that development has reasonably progressed it will be time to do away with a principle so strongly adhered to in railroading. The horse pulls the wagon, let the locomotive pull the cars.

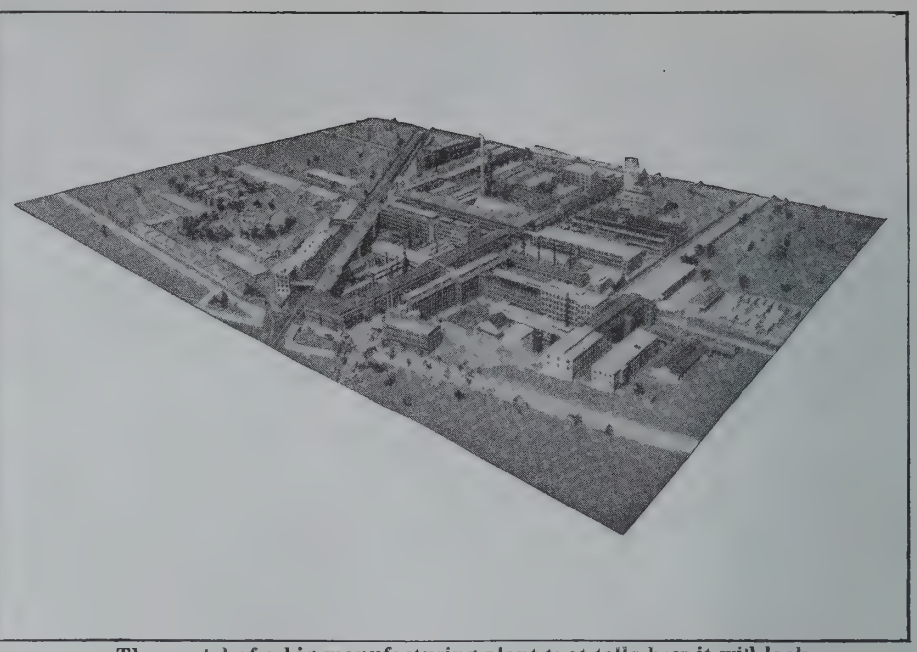
The ultimate result of the electrified railroad must be that the cars pull themselves, headed by a small auxiliary locomotive or the baggage car. The economies inherent in this principle, both in maintaining the roadbed and in eliminating the big locomotive should speedily help to pay the cost of the electrification of the railroad.

V. HANSEN.

Wallace, Idaho.



Engineer's model of the basement of the Woolworth Building, of great aid in the construction work



The model of a big manufacturing plant tnat tells how it will look long before it is finished

# Toys That Do Great Work

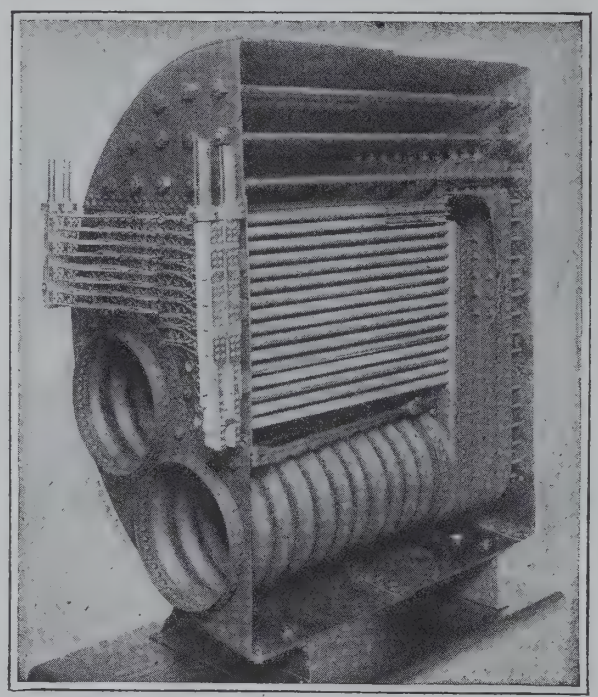
## The Indispensable Place Occupied by Models in the Engineering of Today

By M. A. Henry

A MODEL engine, or a model steamship or skyscraper is not always a toy or merely a thing of sentimental value. We too often think of a model as the work of a "tinkerer" and are apt to forget that model making has its definite place in modern industry and that the model maker is a highly skilled workman who works with great precision.

Recently at an important murder trial a model of the scene of the tragedy was introduced to show more clearly to the jury "just how it happened." The model had been made by a "tinkerer." It was shown to be inaccurate and was ruled out as evidence. The professional model maker knows that one of the most important uses for models is in lawsuits and he knows that this may prove a most exacting test for the accuracy of his work.

During the war an engineering firm undertook the erection of a large drydock for the Navy at Seattle, Wash. It was found that because of conditions which could not have been foreseen, a great deal more construction work than had been thought necessary was required. Suit was finally brought against the Navy for the extra expense incurred. The case was a very complicated one and difficult to present to a jury of non-technical men. The attorney for the company admitted he had failed to "put across" his point and then a happy thought occurred. He called in Horace E. Boucher, a famous model maker of New York, a model was constructed to exact scale and the jury could then be readily shown the point at issue. The model served its purpose so well that it "saved the day."



Model of a boiler, showing tubes and all other features

For the trial of another suit, involving the patent rights for a well known make of steam turbine, more than $3,000 worth of models were constructed and used as evidence.

In the trial of the German, Fay, who was caught attaching bombs to the stern of vessels, a model was again used to advantage. The bomb Fay used was attached so that it was actuated by the ship's rudder in much the same manner as the balance wheel of a watch regulates its movement. Fay had calculated the number of turns the ship would make so that the bomb would explode after the ship was well at sea. The whole conception was so fantastic that to convince the jury a six-foot model of a ship's stern was made and a small working model of Fay's bomb (minus the explosives) was attached. Fay was convicted.

There are almost countless other instances where models have played important parts in lawsuits, but this is not their only practical use. They are very essential in the shipbuilding industry. For every steel ship built a "plating model" is made. This is a wooden form of half of the ship's hull. On this the steel plates of which the real hull will be made are laid out and the plates are ordered from this model. This is necessary because of the irregular shape of the hull, making an accurate blue-print impossible. Another model of the hull is made and towed in a testing tank and its resistance to motion in the water

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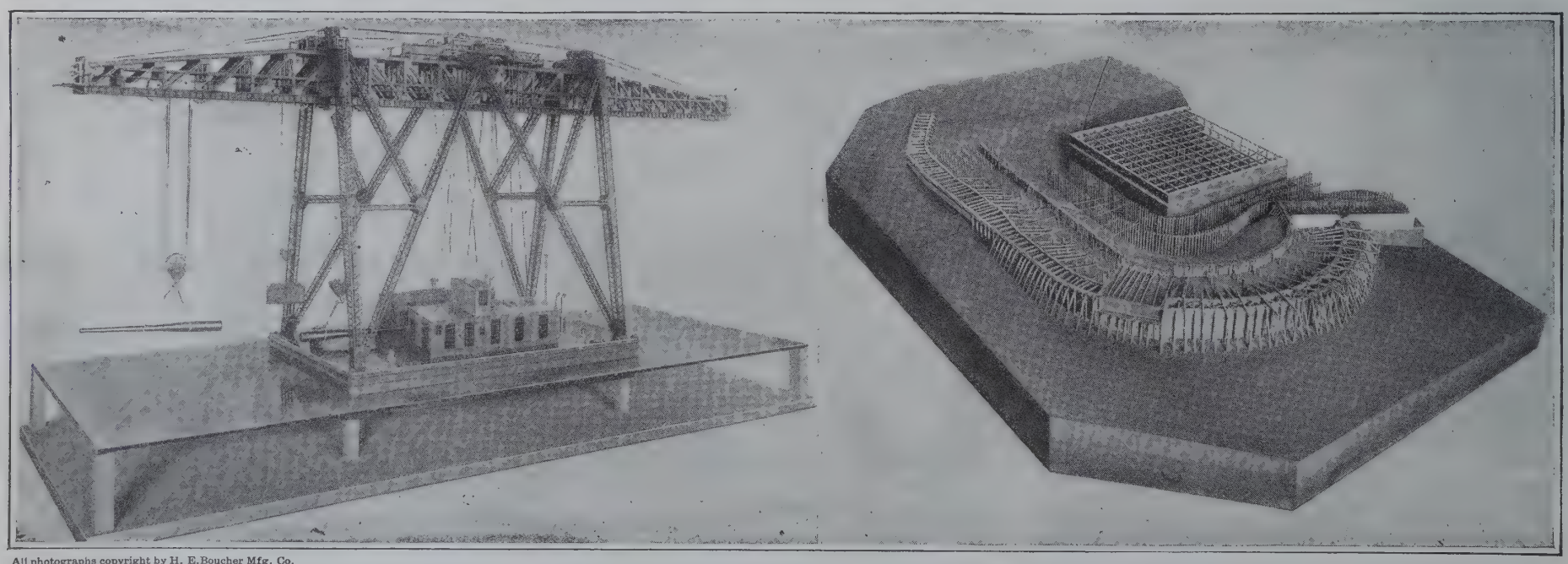


All photographs copyright by H. E.Boucher Mfg. Co.

If the model will do its work, the engineer is safe in assuming that the finished crane will be equal to the demands made upon it

A model built for the guidance of the construction foreman on a big coffer-dam and caisson job

### Bill Boards That Travel Through the Streets

SAN FRANCISCO has a new and quite unique way of combining business with pleasure. The "Baseball Special," a string of trolley cars running to the ball grounds, carries a huge poster which advertises the date and time of each game. Only one side of the car carries the bill board, the other side being left free for light and air.

### A Machine That Is Rougher than the Freight Handlers

IN a test for strength of shipping boxes, the object of which is a simulation of the rough knocks, bumps, and jars of handling which a loaded box may encounter in railroad traffic, there has been designed a machine by which the railroad usage which a box may meet in a 2,000-mile haul can be duplicated in four or five minutes.

The first machine of this kind, known as the drum box-testing machine, was designed by the United States Government Forest Products Laboratory at Madison, Wis. The Mellon Institute of Industrial Research of Pittsburgh, Pa., has recently installed a machine which is said to be an improvement over the original tester in that the inconvenience of overhead pulleys and shafting has been done away with by the substitution of a reduction gear for cutting down the motor speed to the drum speed of two revolutions per minute.

A valuable field of investigation and scientific study of construction and materials of packages is opened up by the new machine, such as best methods of interior and exterior packing for fragile or irregularly shaped objects; the determination of proper specifications for containers carrying various commodities, etc. An offer of free service in the designing of scientific packing methods for the various commodities capable of being shipped in fiber containers, which includes the use of this equipment, is being advertised by the Container Club of Chicago, an association composed of corrugated and solid fiber box manufacturers of the United States.

### A New Use for the Old Diving Bell

ALWAYS seeking new fields of exploitation, the motion picture producer is not one who hesitates to plunge into something new in the way of submarine devices. Indeed, the Williamson submarine tube, which for years had little if any real promise of practical application, suddenly came into its own as a means for producing marvelous underwater scenes for the motion picture screen. And now a Western inventor, A. B. Barringer, has worked out a modified form of diving bell shown in the accompanying illustration, for the purpose of taking submarine pictures.

The Barringer equipment is the usual diving bell construction, but instead of being open at the bottom, it is closed. A heavy plate-glass window is provided in one side of the steel shell in order to operate a motion picture camera or the usual "still" photograph equipment. Air is furnished to the operator by means of a conventional air pump. Weights are mounted about the casing in order to secure the desired results. So far, tests of this equipment have been highly successful, and the screen may soon be favored with a fresh lot of submarine pictures which are always fascinating to us creatures who live in a different element.

### The Largest Motor Boat Afloat

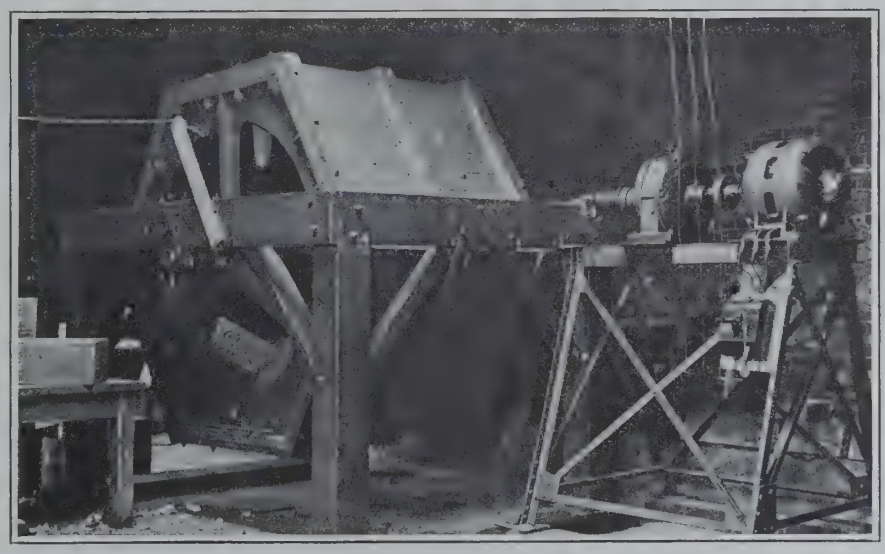
IF you let your eye range down the full 445 feet of deck length of the fine freighter shown in our photograph you will notice at once, if you are familiar with ships, that she has no smokestack—and this of course proclaims her to be a Diesel-engined vessel. The "Africa" has recently been built in Copenhagen for a London company. She is 445 feet in length, has a beam of 60 feet, and her carrying capacity is 14,000 tons. She is driven by Diesel engines of 4,500 horsepower, and on the strength of her power and size she is credited with being the largest motor boat in the world.

This vessel and other large Diesel-engined ships which have recently been built or are now upon the ways, show that the internal combustion engine is steadily, if rather slowly, making headway as a successful drive for ships of the largest size. This advance would be more rapid were it not for the limitations of size of individual cylinder dimensions imposed by internal combustion conditions. In the present state of the art there is a point at which cylinder capacity for the single cylinder is restricted, and this being so, it becomes necessary to resort to a great multiplication of cylinders in order to reach a large total power output on the propeller shafts. The Germans, at least up to the close of the war, seemed to have advanced further than other engineers in this direction. If a satisfactory gas turbine should ever be developed, the question would be solved for ships of the largest power. The advantages in fuel economy, increased cargo space, reduction of engine and boiler room force, to say nothing of the speed and convenience of fueling, are motives which are urging marine engineers to bend every effort to the solution of this problem.

Copyright, Keystone View Co.

**This string of cars, running to the San Francisco ball grounds, carries bill boards to advertise the games**

**The "Africa," largest motor-driven ship afloat. Length 445 feet; beam 60 feet; tonnage capacity 14,000**

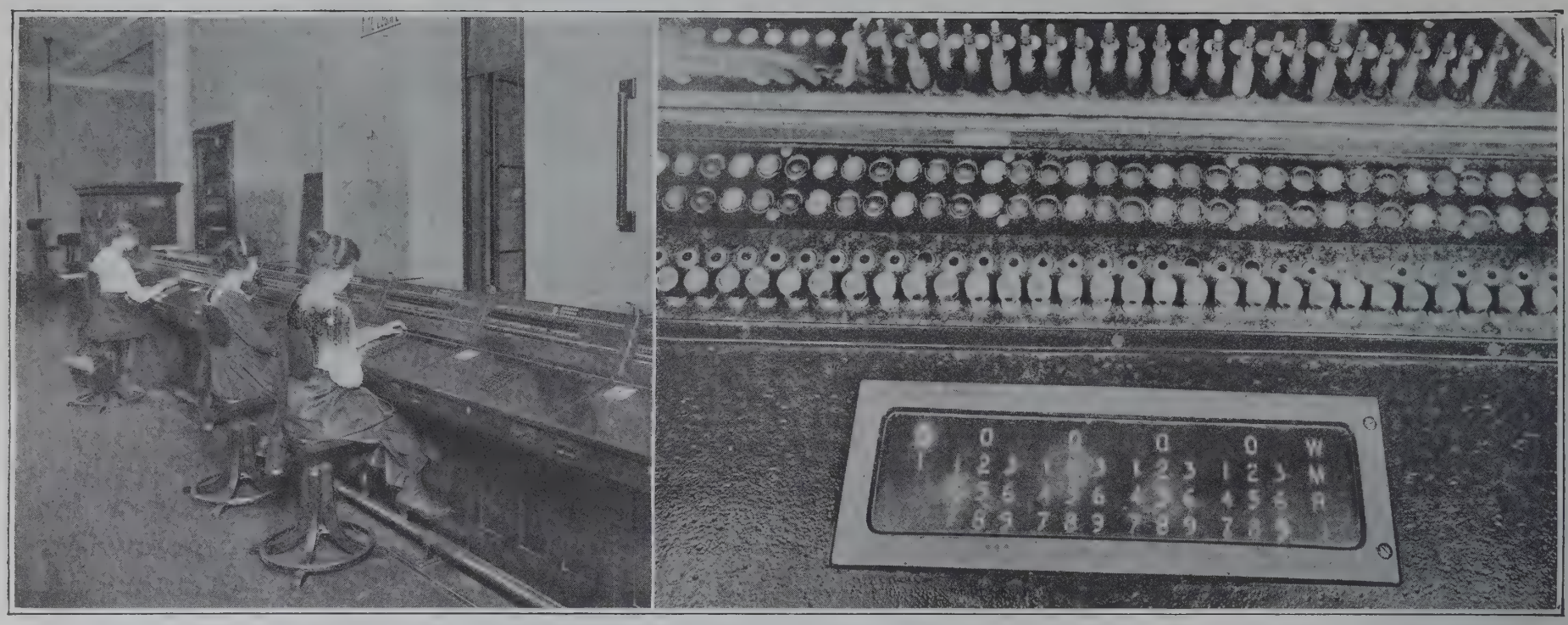


**Turning at two revolutions per minute, this machine simulates the treatment a box receives on a 2,000-mile railroad trip**

**New form of diving apparatus developed by a western inventor for enabling motion pictures to be taken under water**

### Other Metals with Radioactive Properties

IN addition to the ordinary radioactive substances, which are all closely related to uranium and thorium, two elements of the lightest atomic weights known, only two of the light metals of relatively small atomic weights, potassium and rubidium, seem to be radioactive to a certain extent. The nature of this latter radioactivity is by no means understood, while a great deal is known as to the character of the ordinary radioactivity. In case of the radium and the other radioactive elements there is certainly a decay of atoms. As regards potassium and rubidium we have no definite evidence of any decay. In discussing these problems in the *Physikalische Zeitschrift* some time ago, Otto Hahn and the late Martin Rothenbach point out that, while several investigators are convinced that these alkali metals emit beta rays, alpha rays have not been discovered; it is on the other hand striking that the potassium salt deposits of Stassfurt are rich in helium. The radioactivity of the alkali metals might be due to some impurity; but no impurity has been traced, and the radioactiviey observed is always proportional to the potassium percentage, *e. g.*, the intensity of the radiation from potassium which was first observed by N. Campbell at Cambridge in 1906, is very small; yet it was considered to be at least 10 times stronger than that from rubidium. Hahn and Rothenbach made their experiments especially on the sulfates of potassium, rubidium and caesium, with the aid of electroscopes of unusually large dimensions. The following are the conclusions at which they arrived: There is no indication of the presence in rubidium of some isotope; the beta rays from rubidium seem in penetrating power to stand between uranium X and radium proper; the ratio of the activities in rubidium to uranium as 1:15, and rubidium to thorium as 1:10; the life period of potassium would probably be from three to seven times longer than that of rubidium. Speculations have been made by others as to a possible production of strontium from rubidium, calcium from potassium, and barium from caesium; but such speculations appear to be quite arbitrary for the present.



*Left:* Typical installation of "cordless B" positions in a machine switching office. *Right:* Call indicator at an incoming trunk position in a manual office showing number 4259 displayed.

**Two of the clever dodges whereby the automatic telephone is enabled, pending its complete installation throughout the city, to work with the manual offices**

# The Mechanical Hello Girl

## An Automatic Telephone Switchboard That Can Take Care of the Busiest Exchange

By H. A. Mount

THE automatic telephone is not new. Efforts to build a telephone system in which any subscriber could be automatically connected with any other desired subscriber without the aid of a human hand, began in 1879, only three years after Dr. Bell produced the telephone.

But an automatic telephone exchange in a big city, such as New York, where there are in the neighborhood of a million telephone stations served by 100 central offices is decidedly new and of great significance. In the years between 1879 and the present many inventors have tackled the problem and there have been many systems of automatic telephony invented. Automatic telephones have been used successfully in towns and smaller cities for several years but their introduction into the big centers of population like Chicago, Philadelphia or Boston presented obstacles which seemed well nigh insurmountable.

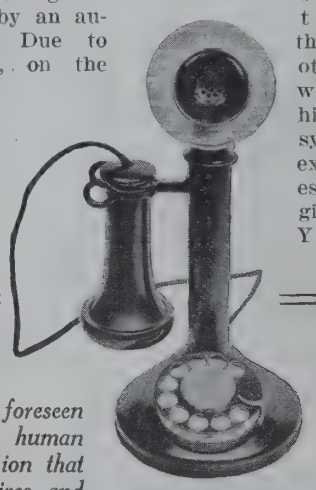
Where a community is served with a single central office or two or three central offices the engineering problem was comparatively simple. A system had to be devised which merely made it possible for any subscriber in the system to reach any other subscriber.

But in New York not only must each of the 1,000,000 subscribers be able to reach any other, but due to the large area involved, many of the calls involve extra charges, which means that they must be supervised, timed and ticketed. Then there are the following general classes of service demanded by the public: Flat rate limited, message rate, official, coin box unlimited, and pay station. Add to this single party, two party and four party service and picture a densely populated surrounding country with several hundred towns and cities from which come and to which go thousands of messages each day, all of which have to be supervised, timed and recorded.

That an automatic telephone system capable of doing all these things and many others could be devised seems little short of marvelous. And yet the biggest problem of all was not in doing these things, but in devising a system which would operate in harmony with the existing manual central offices.

It will be seen that the task involved in changing to automatic telephones in a large city is stupendous and it would be a physical impossibility to convert the whole system at one time. The change must take place gradually, one central office at a time changing to automatic switching, until the whole job is accomplished. The change must be made without interruption of service and for a period of some years the new automatic apparatus must work in harmony with manual apparatus.

The first part of New York's automatic system is now in operation and the whole city is to be converted to automatic switching as fast as apparatus can be manufactured and installed. The process will be so slow, however, that telephone officials say they will not have to discharge a single operator replaced by an automatic switchboard. Due to the normal labor turnover, on the other hand, the company will have continually to hire more operators. The system is constantly being extended, too, and it is the estimate of telephone engineers that in 1950 New York will have at least 2,700,000 stations served by 225 offices.



*THE telephone system has attained a complexity which its inventor could hardly have foreseen when he was struggling to reproduce the human voice at the other end of a wire. The suggestion that all the business of this vast network of wires and switches might be performed automatically seems at first blush preposterous. But every day it is harder to recruit the army of operators needed for the manual exchanges. It becomes ever more necessary to devise, not a means of doing away with the operator, but merely of getting along with the operators that can be obtained. Largely on this account a determined effort has been made to apply automatic telephony to the large and busy exchange as well as to the small and comparatively idle ones; and incredible as it may seem, this has been a complete success. We may look forward with certainty to the day when any two instruments in New York City may be connected without the intermediate agency of any human operator. This is the story which Mr. Mount presents to us here.*—THE EDITOR.

The first makers of automatic telephones had a single exchange to deal with and only a few subscribers. The first machine switches produced had a separate switch for each line, so arranged that it could find and connect directly with any other line in the exchange. The long adherence to this plan was probably one of the principal causes for failure of these early systems. The first systems to succeed to any marked extent made use of a scheme of trunking whereby the calling line was extended link by link until it reached the called line on a very much smaller multiple group than the total number of lines in the exchange.

The first system to find any commercial application makes use of this fundamental trunking principle. The switches are the "up and around" type with 10 vertical and 10 rotary steps, each switch accommodating 100 lines or 100 trunks. A dial with the 10 digits 1 to 0 is provided at each subscriber's station. The subscriber in calling manipulates this dial. This sends impulses to the switches, which cause them to build up the connection desired.

For example, when a subscriber calls a four digit number, as 9653 in a 10,000-line system, the first movement of the dial by the calling subscriber will send nine impulses to the central office corresponding to the thousandths digit, and the switch under direct control of these impulses will step up nine times and extend the line to another switch which serves the ninth thousand. The next movement of the dial will send six impulses and this will cause the switch of the ninth thousand to step up six times and extend the line to a switch which is capable of reaching the hundred lines of the sixth hundred of the ninth thousand. The next movement of the dial will send five impulses to correspond to the tens digit and will cause this last switch to step up five times. The last movement of the dial will send three impulses which will cause this same switch to take three rotary steps and thereby complete the connection. Of course the system is more complicated than this because there is machinery for automatic ringing, for giving busy signals, and the like. But most of the automatic systems in use follow these general lines. There have been many minor improvements in this system but the general principle has not been altered.

More recently there has been devised the "automanual" system, which as its name implies, includes some of the features of both the automatic and manual systems. In this system the subscriber calls central and gives his number in the usual fashion. But Central sets up the number on a switchboard with very much the appearance of an adding machine and the switching is done automatically.

There were several reasons why these systems, although used successfully in many places, could not be adapted to the needs of large cities. It was found that too great a mass of machinery and equipment would be needed and to meet this objection a new type of switch

had to be devised. The basic necessity of having a large number of trunks in one group added another difficulty—the system could not be laid out on a 10 x 10 or decimal basis. At the same time it was obviously desirable that the calling device be operated by the subscriber on a decimal basis. With a large number of trunks in one group, it was found that there was not sufficient time between one set of impulses and the next to permit the switches to hunt and find an idle path or trunk.

To meet these and other objections the "sender" was devised and it is declared to be the greatest single advance in the art since the selector switch. Instead of controlling the switches directly by the impulses from the subscriber's dial, these impulses are received and literally stored up by the sender. The sender then allows the switches to go upward to the desired point and then stops them by removing their driving power. This permits the usual decimal system of numbering, but the sender can be arranged to translate these decimal impulses to any desired non-decimal system, permitting the most advantageous arrangement of wiring and switches to meet any given condition. It permits the elevators or switches to hunt over any number of trunks in a group without any reference to the speed of the calling device. This fact permits the building of rugged power-driven switches which can be operated at their best speed on circuits local to the central office. It solves the most serious problems of the large cities by permitting the most economical arrangement of trunks outgoing from any office; it allows trunk groups to be made larger or smaller and permits shifting the multiple from one place to another to meet changing conditions. Thus, the sender makes the system flexible and less costly and the most economical layout can be used without fear that future expansion in any direction will be blocked.

It must be remembered, however, that the transition period in a large city extends over a number of years and during at least half of this time most of the calls would originate in manual offices. One of the chief problems to be met was finding a satisfactory method of sending calls from manual offices to mechanical offices and from mechanical to manual offices.

Three successful methods of handling service from manual to mechanical offices have been worked out, each best suited to a certain condition. In the simplest of these, the manual operator is provided with a dial similar to the subscriber's dial and when she receives a call for a mechanical station she dials it for the subscriber, having first "plugged in" on an idle trunk line.

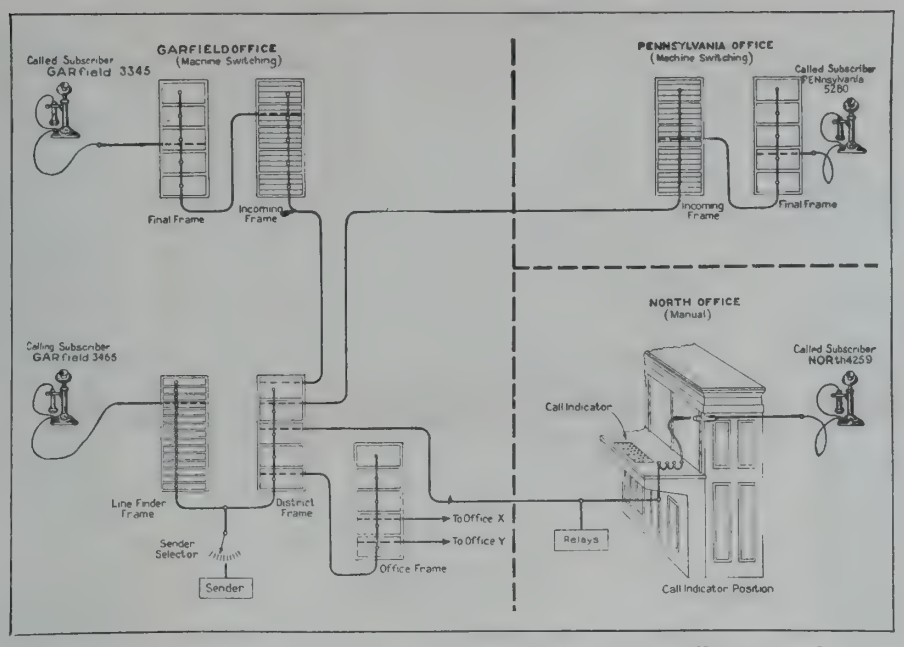



**Diagram showing progress of a call from an automatic subscriber to another automatic instrument or to a manual-station subscriber**

The advantage of this system is its low first cost but it has the disadvantage that where the number of calls is large it slows down the operator. It will be used only in small cities where traffic is light.

Another is called the "key indicator" plan, and permits the manual operator to complete a call to a mechanical office very speedily without the aid of any other operator. When the subscriber gives the number desired, if it is in a mechanical office, the operator depresses a key corresponding to that office and an idle trunk line is automatically selected for her and indicated by the flashing of a small lamp. She "plugs in" on this line, having depressed the digits of the desired subscriber's number on a 10-button "numerical key" with which she is provided. A "sender" which has been attached automatically proceeds to guide the connections in the distant mechanical office. This plan is to be used in offices where it is proposed to retain the manual equipment for a number of years, as it involves a large cost and extensive changes of equipment in the manual office.

The third plan and the one to be quite frequently used is the scheme of using "cordless B" operators in the mechanical offices. The plan contemplates that the call will come in to the manual switchboard in the usual way and that the operator will handle the call as though it were to another manual office. At the incoming end, the "cordless B" operator will receive the number and will set up the number on the keys before her. A "sender" is provided to receive and register this number and to cause the desired line to be found and rung. This plan has the advantage that no changes are necessary in the manual office.

Calls from a mechanical to a manual office are always handled in the same manner. The manual operator has before her a "call indicator" consisting of a table of figures, any one of which can be illuminated by lights beneath them. The incoming call is indicated in the usual manner but instead of having the subscriber repeat the number wanted, it is set up on the "call indicator" by the illuminating of the proper figures. Thus so far as the full mechanical subscriber is concerned a call through a manual office appears to him the same as a call to another subscriber in his office. The operator then puts through the call in the usual manner.

In fact, the progress of a call through a full mechanical system is parallel in a striking way to that of a call through the manual system with which we are familiar and it may make the function of the apparatus more clear if we consider the similarity. When a subscriber in a manual system removes his receiver to make a call, he causes the line relay at the central office to pull up and light a lamp associated with an answering jack. An operator takes up the answering plug of a cord pair, plugs in and answers. In a full mechanical system the subscriber removes his receiver, causing his line relay to pull up but instead of lighting a line lamp, it applies current to a row of contacts on the "line finder banks" and starts an elevator called a "line finder" going upward in search of this row of contacts. When the line finder reaches his contacts it is caused to stop by having its driving power removed.

Thus there is a marked similarity between the answering jack and the line finder contacts of the line finder bank; between the line finder and the answering cord; and between the operator finding and plugging in to an answering jack and the line finder finding and attaching itself to the contacts on the bank. After this, in the manual system, the operator, after plugging in, throws a listening key and she notifies the subscriber she is ready to receive his order by saying "number, please." In the mechanical system the "line finder" has associated with it a "sender selector" which proceeds to find and attach an idle "sender" during the period that it is finding the calling subscriber's line. The "sender" notifies the calling sub-

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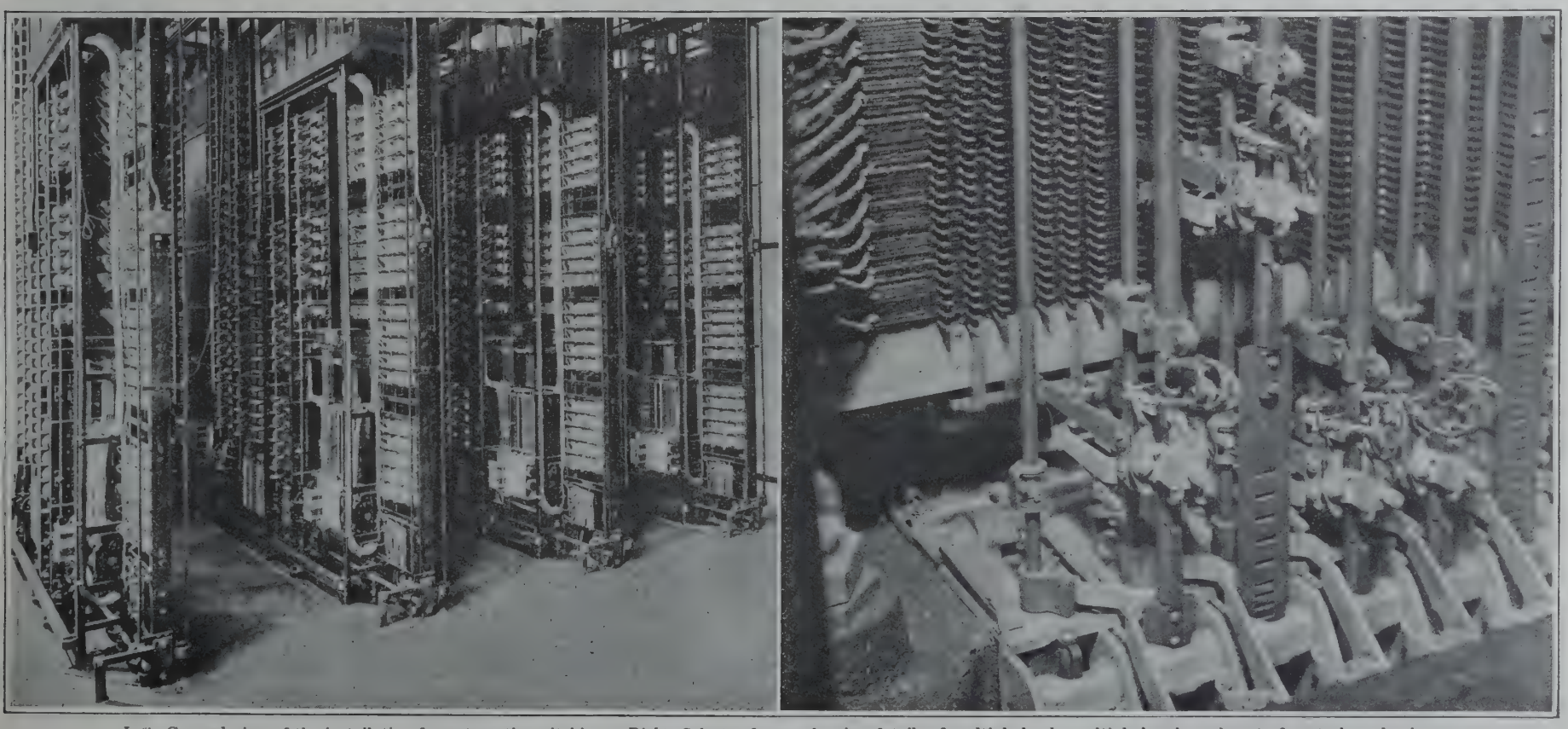


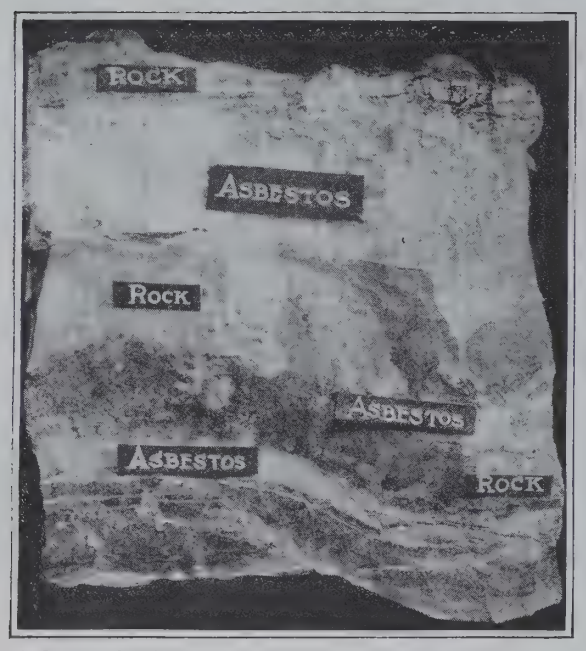
*Left:* General view of the installation for automatic switching. *Right:* Selector frame, showing details of multiple bank, multiple brush, and part of control mechanism.

**The apparatus that makes automatic telephony a success in the busiest exchanges**

# The Rôle of Asbestos

## Some Facts Bearing on the Growing Importance of This Substance in Industry and Architecture

By Ralph Howard




**Asbestos in the natural state, showing characteristic layer formation**

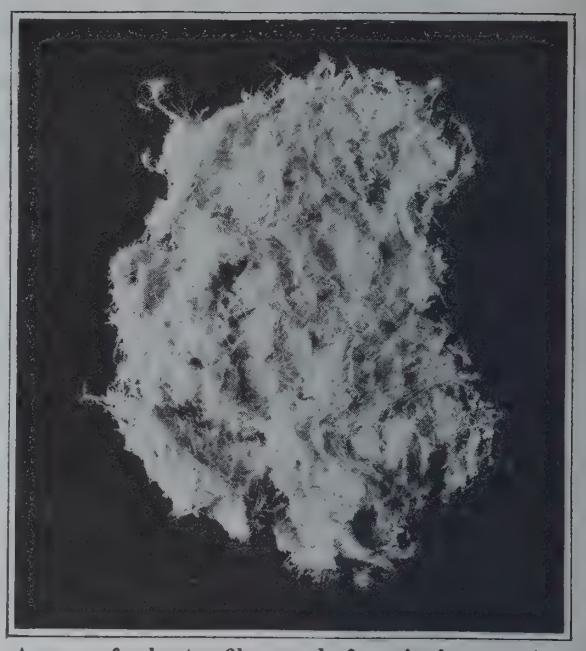
FOR centuries asbestos was but a curiosity—a mystic mineral paradox, to all appearances a solid rock yet composed of silk-like fibers so rugged in themselves that the millions of years of the earth's cooling, hardening and cracking did not break these slender threads. The ancients knew something of asbestos and held it in great awe because of the weird superstitions about its origin and powers that had been built up around it. Our early scientists knew of the properties of asbestos but it was not until something over half a century ago that the first experiments were made for using it on a commercial scale. From then on its uses grew in leaps and bounds until today it is a recognized commercial, industrial, and domestic necessity. Developed by the vision and efforts of a few great business institutions, this curio of the ancients now contributes to the world's progress and makes life safer and more complete in an almost infinite number of ways.

To look at a bunch of asbestos fiber one would think it would blaze up at the touch of a lighted match or dissolve when brought into contact with acids—yet it resists high temperatures and practically all commercial acids, the wear and tear of friction and the elements. It looks delicate, yet it can be spun into very strong yarns. While the rock itself is heavy yet these yarns can be woven into cloth weighing less than 16 ounces to the square yard, or thread weighing about one ounce to the hundred yards. The length of the fibers themselves ranges from a fraction of an inch to 4½ inches.

The almost inestimable economic value of asbestos proceeds from the fact that it possesses such an unparalleled combination of heat- and wear-resisting qualities. It is practically indestructible and resists decay and destruction under almost every condition of heat and moisture. It withstands high temperatures and has a low heat conductivity. It is a non-conductor of electricity, has a high coefficient of friction, considerable tensile strength, flexibility and elasticity. It is unchanged by flame or temperatures up to 1,500 degrees Fahrenheit, defies erosion, and is immune to climatic or atmospheric conditions.

One of the most important results of the development of asbestos has been the saving of heat through insulation—insulations that retard the escape of heat from boilers, furnaces, pipes and flues. The perfection of the heat (and cold) insulations and their application to thousands of America's power plants, is saving power and saving fuel—millions of dollars' worth annually and with the increasing cost of coal this economy is correspondingly greater.

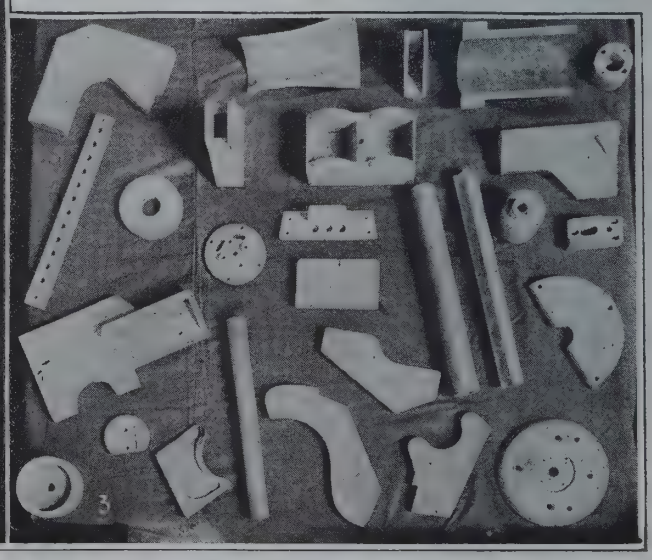
The commercial forms of asbestos insulating materials are quite varied but the most familiar types are the sectional pipe insulations, blocks and cements used in the conservation of heat on superheat, high-pressure, low-pressure, hot water heating and circulating lines, inside and outside, overhead and underground. Asbestos insulations are highly efficient, in fact, are capable of maintaining a difference between steam inside the pipe and air outside of some five hundred odd degrees. This is a praiseworthy service not only in its mechanical ingenuity but in the conservation of every unit of heat energy necessary to maintain production at its maximum and also conserves our natural fuel resources which statistics tell us are being dissipated at an accelerated rate.



**A mass of asbestos fiber ready for spinning, matting and molding**

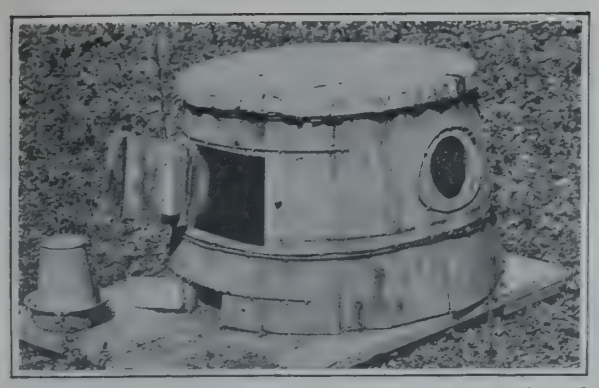
In addition to the saving of heat units in boilers, pipe lines, etc., asbestos is indispensable in the factory and power plant in the form of packing for air-brake cylinders and for all kinds of rods, pistons, plungers, and flanges against steam, water, air, brine, ammonia, oil, gasoline, acids and alkalies. It is invaluable as conveyer belting for handling hot slag, cinders and other materials requiring a fireproof fabric. It finds employment in helmets, aprons, coats, leggings, shoes, etc., for the protection of workmen, especially in foundries, steel mills, and glass works, where molten metals and glass are a constant source of danger to life. It is also made in the form of cords, twines, rope, yarns, paper, roll board and mill board for conditions where metal or organic materials would be quickly destroyed by the attacks of heat or acids. As a tape made as thin as 0.025 inch and as braided tubing it is used as a protective fireproof covering for conductor wires, cables, armature windings, field coils, etc., to prevent the spread of flame in case of short circuit, particularly on heavy service apparatus such as rolling mill, traction and crane motors, lifting magnets and other machinery which are in constant danger of being burned out. Also it is extensively used in compound with mica and more brittle non-conducting materials to which it gives body and elasticity. In the chemical industry it has made some electrolytic processes a success where they had previously been badly handicapped or utterly impossible. It is the logical material for filtering acids and alkalies because of its immunity to their action and the fact that it is an absolute neutral substance and does not change or

(*Continued on page 52*)



*Left:* Insulating tubes and blocks for pipes, boilers, flues and stacks. *Center:* Asbestos garment for working amidst molten metal, glass, acids, and in intense heat. *Right:* A few of the infinite variety of useful shapes into which asbestos, alone or in combination with other materials, can be molded for structural and mechanical parts where resistance to heat or to wear is essential.

**A very sketchy exhibit of the diverse rôles played by asbestos in modern affairs**



**Considerable ingenuity is shown in the construction of this chicken coop from half of an ordinary barrel**

### A Chicken Coop from a Barrel

INGENUITY on the farm is typified by the chicken coop shown in the illustration herewith. This coop is made from half of an old barrel, with appropriate trimmings. The top is covered with heavy burlap, neatly nailed, and with the nails prevented from tearing through by metal caps, as shown in the photograph. The barrel is handsomely reinforced with heavy wire—a necessity in view of the fact that the other end with its usual binding hoops is absent, leaving the staves without adequate support. With an opening cut for the mother hen to survey the neighborhood through, and a smaller one beneath it for the chicks as they pass in and out, in addition to the ventilation ports covered with netting, it will be seen that the biddy is fixed up in great shape when she establishes her headquarters in this cleverly got-up coop. Stability is added by a wooden platform, and hooks to tie the superstructure firmly down upon this.

### What the All-Metal Airplane Can Do

THE war being over, the German aeronautical designers and constructors have turned their attention to the problems of commercial flying. And in this respect they have a decided advantage over their rivals in other countries. During the latter part of the war the Germans evolved an all-metal airplane which did excellent work at the front; and this very same construction is now outrivaling anything that can possibly be done with the wood-and-canvas construction which at present distinguishes the operations of British, French, Italian and American builders.

On June 27th last, the Larsen all-metal monoplane made a non-stop flight from Omaha, Neb., to a point 20 miles east of Lancaster, Pa. Had it not been for the dense haze which interfered with the navigation of the monoplane, it is said that the flight would have been continued to Central Park, L. I., some 25 miles east of New York City. As it is, this flight broke all non-stop records for the United States.

However, this flight is only a means of focusing public attention on the merits of the all-metal monoplane. There are still a few surprises in store for the public—aeronautic experts have already expressed themselves as regards this new construction, and they will certainly be disappointed if it does not accomplish some remarkable feats in the very near future. At the recent Aeronautic Congress held at Atlantic City, the same plane, J. L. 6, flew from Atlantic City Airport to Philadelphia and return, a distance of about 130 miles in the record time of 59 minutes and 34 seconds. It carried a total of six persons along with 80 gallons of fuel. A 185-horse-power motor was used in this flight. In the efficiency tests over the same course a J. L. 6 monoplane equipped with a Mercedes 160-horse-power motor carried eight passengers. The distance was covered in one hour and 28 minutes, and the fuel consumption was 12½ gallons for the round trip. On a trip from Atlantic City to Central Park, Long Island, the J. L. 6 carried five passengers and 143 pounds of luggage, a total weight of 1,082 pounds, horse-power used. The distance covered was about 110 miles, and in spite of the fact that the plane with its heavy load climbed to a height of 20,600 feet, it completed the trip in 80 minutes. When the all-metal plane was first reported, it was met with considerable skepticism, and naturally so; but it has easily established its position as one of the headliners of modern aero practise.

The all-metal monoplane has been introduced in this country by Mr. John M. Larsen, who has made an extensive study of aviation in the leading European countries. The machine is largely the design of Mr. Larsen, but the thick wing and metal construction features are due to Dr. Hugo Junker, whose name meant so much in German aviation during the war. In fact, this machine is a peacetime version of the famous Junker all-metal fighting plane.

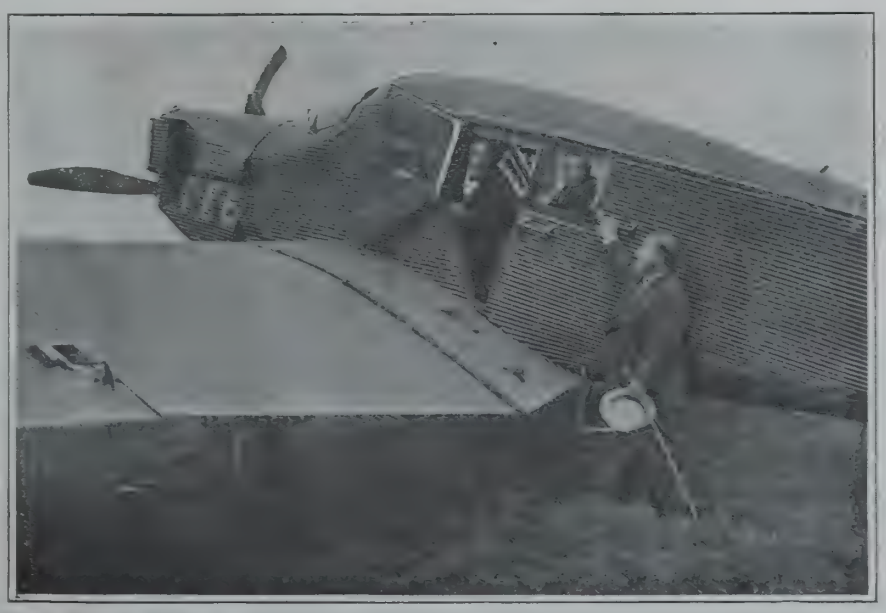
It is claimed by Mr. Larsen that his monoplane will carry six to eight persons at an average speed of 112 miles per hour with only a 160-horse-power motor, throttled some; and with a six-cylinder 185-horse-power motor (no surcharging) this machine has actually taken eight persons over 22,000 feet high—a world's altitude record for an airplane carrying eight people. This and other similar performances, it is held, amount to more than double the efficiency the average plane of today is showing.

By way of comparison in the matter of size, we present an excellent view of the huge monoplane flying boat, developed for the German navy early in 1918. This machine is also of all-metal construction. The wings, as in the Larsen machine, are covered with corrugated aluminum composition. Four Maybach six-cylinder engines deliver their power to a pair of propellers and a pair of tractors. The speed is about 90 miles per hour, and the machine is capable of carrying a load of several tons.

**Huge monoplane flying boat of all-metal construction, developed for the German navy in 1918**

### Color of Brick

NOT only the ingredients in clay but the temperature at which it is burned has an influence upon the color of brick. An increase in iron is usually shown by an increase in the redness of clay. At a red heat a salmon color is obtained which becomes a deeper red as the temperature attains 1800° or 1900°F. Above this heat purple tones appear, followed by a chocolate brown and ultimately black. Buff shades are due to lime and alumina. Excess air in the kiln tends to produce a red color, while a smoky atmosphere may usually be depended upon to give a brown or black.



Copyright, Underwood & Underwood

**The Larsen all-metal monoplane which recently broke the American non-stop flight record**

**This little dwelling has been constructed out of packing boxes of all sizes and shapes**

### When Packing Boxes Solve the Housing Problem

WE will not take up the reader's time by telling him about the housing shortage. That fact is pretty generally known. It is a universal problem.

A New York postman recently found himself confronted with the steadily shrinking dollar and the over-ambitious landlord. Unable to make both ends meet, he decided to build his own house on a small plot of ground near the city line. In order to get away from the high cost of building materials, this postman went to work and bought all the packing boxes he could lay his hands on. Furniture crates, piano boxes, canned-goods boxes, dry goods cases—all manner of odd sized and shaped boxes were sent out to his little plot. These he converted into a small dwelling during his spare moments, as shown in the accompanying illustration.

### Things That Go with the Car

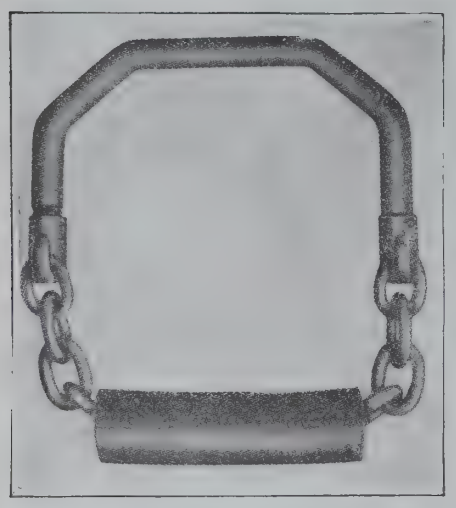
EVERY imaginable item of equipment is furnished on some of the new models for 1920, including shock absorbers front and rear, motometer, cowl ventilator, transmission theft-lock, muffler cut-out, emergency gasoline valve, located on the heel board of the rear seat and giving 1½ gallons additional supply, rubber foot-pedal pads, tire pump on the transmission, Yale locked double tire carrier, and many lesser items. Great care is being taken in the attachment of spare wheel and tire carriers, these being of exceptionally substantial construction and made an integral part of the chassis instead of being an afterthought, both in construction and appearance, as in the past.

Luxurious closed cars, especially the sedan and coupe, were again the headliners of the New York Automobile show, and the interest that is being evidenced in them more than justifies the manufacturer in increasing his production of these owner-driven all-season models during the present season. Aluminum bodies, custom designed, effect a material saving in car weight and add much to car performance and operating economy. The overall height of some of the sedan and the coupe models is uncommonly low, due to the adoption of the new method of body mounting, and the body lines are straight and unbroken, with graceful curves to relieve even the slightest suggestion of severity. A high, narrow radiator, duplex headlamps of distinctive design, a tapering bonnet of many louvres, a patent leather visor over the windshield, individual front fenders, and wide, sharp-cornered doors are some of the many salient style features of the 1920 sedan and coupe models.

These closed models have many interior appointments in common. These conveniences include a clock on the dash, roll curtains of silk, automatically-locking mechanical lifts for window adjustment, exhaust heater, large octagonal dome light, and door pockets of silk covered with large flaps. In some of the sedans, the auxiliary chairs, facing forward, are dropped out of sight in the back of the front seat when not in use, and corner lights are provided for additional illumination of the rear compartment. A walnut vanity case and smoking set are also included in the equipment items.

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*



**A non-skid grip that is easy to apply**

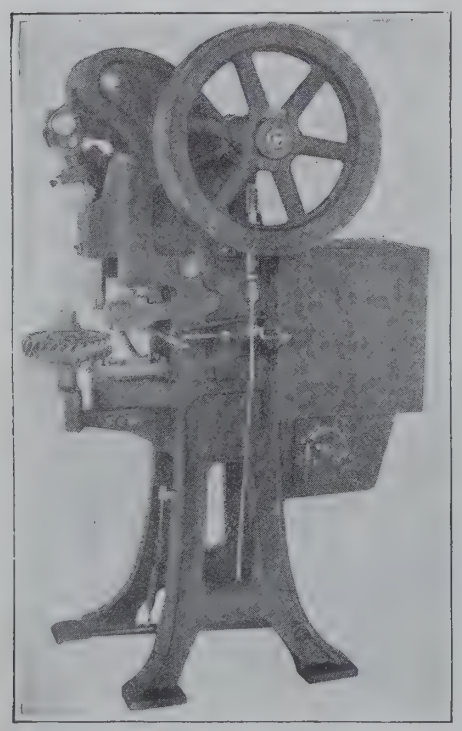
### Non-Skid Grip for Single Tires

A SET of four of these new grips for each rear tire will save the motorist many weary maneuvers in applying a non-skid device to the wheels of his automobile. This grip has obvious advantages over the continuous chain type of non-skid devices and still retains all of the road-gripping qualities the chain possesses. Made so that it fits around the wheel rim and rubber tire very snugly there is no need of adjusting in applying them. A rubber buffer of substantial thickness slips over the chain to keep it from marring up the wood spokes. The part of the device placed next to the tire is made of drop-forged steel. One end of the steel rod is fitted with screw threads and the chain portion is unscrewed when being fitted to the wheel and in operating position is screwed on tightly.—By *Allen P. Child.*

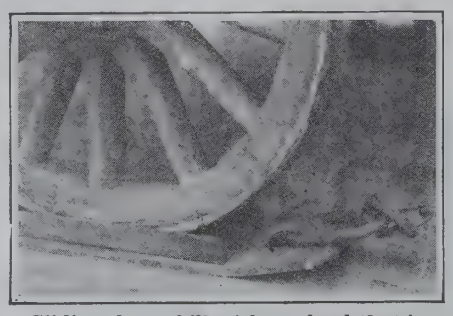
### A New Electric Riveter

AN electric machine designed for welding differential gears has been recently developed by an Ohio manufacturer of electrical machinery. The worm wheel on which the rivets are to be set is supported by a bracket at the front of the machine. This part of the machine consists of a bronze rim in which the teeth are generated, and two cast iron flanges fitting into counterbored recesses on each side of the bronze rim. The worm wheel is carried on a bracket which locates the work in such positions that by simple turns of the wheel successive rivets will be brought into position for heading. Time is saved as this method eliminates adjustments of the work for each heading.

The upper electrode is drawn over toward the operator, in operation, and just above the rivet to be heated by a lever in the operator's right hand. Another lever at the top of the machine is pulled down by the left hand and the electrode is brought into contact with the rivet. The electric circuit is completed and a push button located in the end of the left hand lever is depressed. This brings remote switch into action and current flows through the work and heats the rivet. After the proper temperature is secured the left hand lever is raised and the contact is removed from the rivet. After the right hand lever is released a spring pulls back the electrode and this guards against interference with the steel heading tool which is directly above the rivet at all times.



**Rapid and accurate electric riveting is done by this machine**



**Sliding down-hill with a wheel that is firmly locked against rotation**

### Locking the Wheels to Go Down-Hill

A NOVEL and simple device is used by a San Francisco drayage concern in locking the rear wheel of a heavily loaded wagon in going down the steep streets in that city. The device consists of a flanged piece of metal bolted to a heavy steel shoe. The wagon wheel is kept from moving off the shoe by the flanges. The forward part of the steel shoe is slightly inclined upward, with two slits about 2 inches apart and about 5 inches long. This section of the shoe was then raised and a heavy link inserted as shown to the right in the photograph.

A chain running from the front of the wagon is connected to this link. This device is much more efficient and a great deal safer than the usual method of locking the rear wheel by attaching a chain to the spoke and rim of the wheel.—By *C. W. Geiger.*

### Featherweight Phonograph

THERE is something new in the world of phonographs. A machine has recently been perfected with a weight of but four pounds that produces a tone quality comparing favorably with much larger instruments. The machine plays a ten-inch record and has controlling levers for tone and speed. The horn is made of a fiber board and can be easily removed for traveling. The regular needles provided for larger instruments are used on this smaller machine. The base is made of metal neatly finished in black enamel, is narrow and has a length of about twelve inches. Within the base is a double-action spring that furnishes power for the motor.—By *K. H. Hamilton.*

### How Hard Did It Hit?

A RECENT article described an impact-tester designed by the Bureau of Roads for testing the ability of road surfaces to stand up under hard pounding. But road testing surfaces are not the only things that receive blows, nor are heavy blows the only ones that it may be desired to measure.

For instance, the Department of Agriculture has demonstrated that it is profitable to pick most small fruits in the early morning while it is still cool. The Department's tests have shown that when cool the skin of the fruit is considerably tougher than when warm and less easily bruised. The apparatus for these tests consists of an upright metal standard from the top of which an arm projects to one side, supporting a sensitive coil spring. Attached to the lower end of the latter is a metal rod that passes through a glass tube, the tube being held in place by an arm attached to the upright. A hair-line on tube and rod makes it possible to determine the point at which the tension on the spring balances a given weight. At the lower end of the metal arm a glass rod is attached to which is cemented a small glass needle with a rounded end.

To operate, the fruit is placed on the stand in a holder, and the adjustment made so that the surface of the fruit just comes in contact with the tip of the glass needle when the two hair lines coincide. The tension on the spring is released by means of a rack-and-pinion adjustment, permitting the standard to telescope slowly. The operator is able to tell the instant at which the lessened tension permits the needle to puncture the fruit, since movement of the needle is indicated by movement of one of the hair-lines, easily seen because it destroys the coincidence of the two lines.

**A four-pound phonograph of good tone**

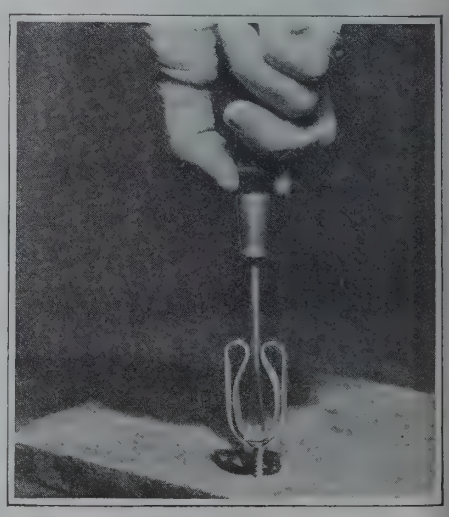
A rather different impact tester is to be found in the Forest Products Laboratory, which has been engaged in a series of tests to determine the relative value of varying species of wood in the construction of airplanes, the resistance to decay as revealed by penetration tests being the determining factor. Port Orford cedar takes first place for its durable quality, while Southern cypress and California redwood are substantially resistant to decay. Douglas fir, white oak, and black walnut proved to be of durable quality.

**Two styles of impact testers used by the Government**

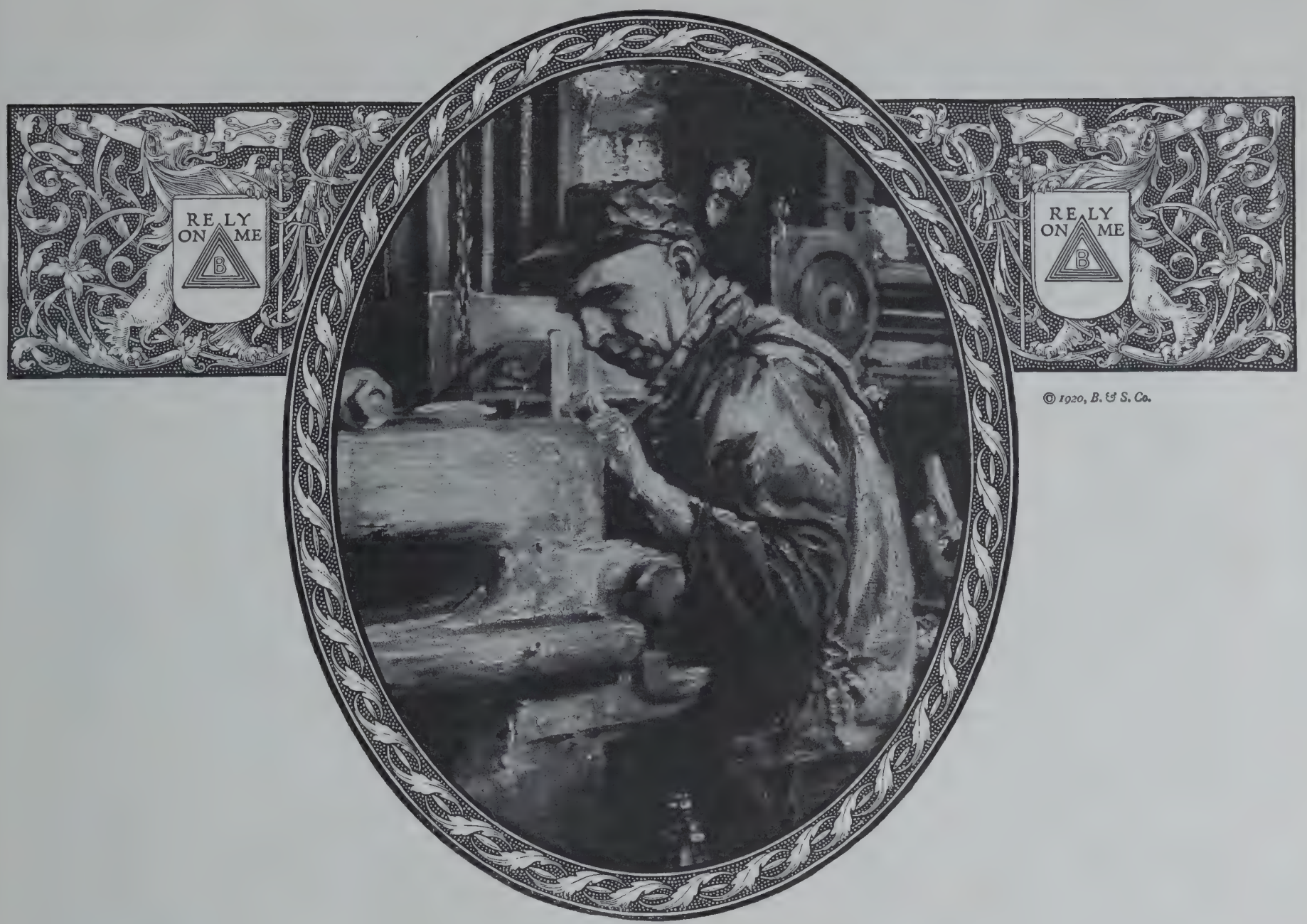
Formerly, the short-lived existence of airplanes rendered the subject of decay immaterial. With improved construction and minimum accidental breakage of airplane parts, the growing needs of replacement because of decay brings to the foreground the relative resisting powers of different species of wood. For instance, spruce timber, the favorite wood for aircraft, is less durable than a dozen other species, according to the government experiments. Basswood, beech, birch and maple are classified as being unable to withstand the powers of decay, with which all mundane things are more or less influenced.

### Driving Screws with One Hand

THE one-handed man will find no difficulty now in driving screws, and his two-handed brother will be able to operate the screw-driver in bad corners where there is no room for a holding hand—there's a place like that on the starting-motor housing of this year's small automobiles. This device, made from spring steel, is so shaped that its fingers hold a screw in place on the end of a screw driver. The upper part of the screw-holder steadies and holds the driver.



**One-hand screw-driver, for use by cripples or in bad corners**

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*CARE, care, everlasting care—from steel analysis through finished Forging, Hand Tool, or Machine—even to the planing of one two-thousandth of an inch off the fifteen ton base of a drop hammer. Such is the realization of a half-century old ideal.*

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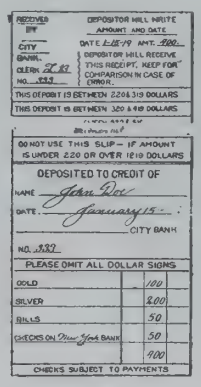
# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

## Of General Interest

DEPOSIT SLIP.—N. E. GOLDBERG, 22 E. 89th St., New York, N. Y. The object of this invention is to provide a deposit slip for use by depositors in depositing bills, coins, checks, coupons and like monetary valuables in banks




A FACE VIEW OF THE DEPOSIT SLIP

and arranged to provide the depositor with a receipt of approximately the amount deposited in addition to the usual entry of the exact amount in the pass book. Another object is to permit the bank of deposit to readily trace any error that may have been made by the receiving teller in the transaction.

DEVICE FOR USE IN BUYING ICE.—J. T. GILBERT, De Funiak Springs, Fla. The invention while adapted for other purposes is more particularly intended for use by a householder in the purchase of ice. The invention especially relates to a device adapted to be placed at the exterior of a house, whereby a coin, ticket or equivalent may be deposited in a receptacle, and a signal displayed bearing numerals indicating the quantity of ice desired; means are provided for locking the device, the signal being automatically removed from display by the raising of the cover of the coin receptacle.

AERO SUBMARINE TORPEDO.—E. A. RIDER, Westbury, L. I., N. Y. The particular object of the device is to provide a high explosive device adapted for dropping from aeroplanes in attacks upon submerged submarines. Among the objects is to provide a torpedo comprising a body with a heavy point

A VERTICAL LONGITUDINAL SECTION, WITH PARTS IN FIRING POSITION

and having its base portion charged with an explosive and equipped with means which after the torpedo enters the water will have a tendency to retard the speed of the projectile, effecting the firing of the charge at a certain determined depth beneath the surface of the water.

SIGNAL POST.—W. O'TOOLE, 1943 E. 30th St., Lorain, Ohio. The object of the invention is to provide a signal post which is of rubber or other suitable material, which if struck by a vehicle will not injure the post or the vehicle, and which is capable of a bending movement with sufficient elasticity to return the post to normal position when permitted, and which when struck will sound an alarm.

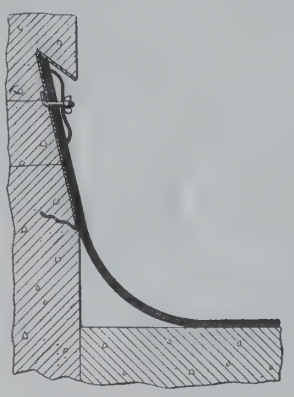
SKIMMING SPOON.—C. F. BEAUFRERE, Central Islip, N. Y. The invention relates generally to skimming devices, and more particularly to a device for removing one of two liquids of different specific gravities which though together are not chemically mixed, the object being the provision of a simple inexpensive device for this purpose which may be readily manufactured of material having a known specific gravity greater than one of the liquids but less than that of the other liquid.

HINGE FOR ARTIFICIAL LEGS.—R. R. DODE, Box 1105, Honolulu, Territory of Hawaii. An object of the invention is to provide a hinge construction with a soft and yieldable pad buffer or stop which will render the closing operation of the hinge soft and resilient, eliminating all closing sounds. The device while particularly intended for use in connection with artificial limbs, may be used in various other ways; it can be built in various forms and designs.

TORPEDO CAPTURING AND DESTROYING NET.—E. KOHLER, Box 3, Alameda, Cal. The invention has reference more particularly to a net which may be cast from a ship and vertically presented in the path of an approaching torpedo to intercept the torpedo in its travel toward the vessel. The primary object is to provide a guard against submarine attacks. A further object is to so construct the guard that it will not only prevent the torpedo from reaching its goal, but the device is capable of also destroying the torpedo.

WALL FLASHING.—W. L. HAWLEY, 2007 E. Washington Ave., North Little Rock, Ark. An object of the invention is to provide a construction of wall flashing which will prevent possibility of leaking at the joint covered by

AN ENLARGED VIEW IN VERTICAL SECTION,



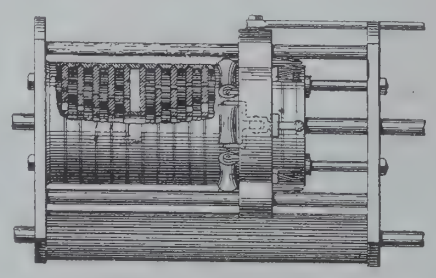
SHOWING THE FLASHING

the flashing. A further object is to provide a wall flashing especially designed for reinforced concrete building structures and which can be anchored in the wall as the latter is built, and which will be comparatively cheap to install and efficient in the performance of its functions.

## Machines and Mechanical Devices

SPRING MOTOR.—O. E. BOAS, 410 No. 5th St., Fort Smith, Ark. The invention has particular reference to means for receiving and holding a coil spring wound to facilitate the insertion of the original within the drum, and to permit of the removal of such spring when broken or otherwise injured and requiring the insertion of a new spring. A further object is to provide means simply constructed, cheap to manufacture and convenient in use.

VARIABLE SPEED TRANSMISSION MECHANISM.—H. G. ALTVATER, 1015 W. 14th St., Denver, Colo. The object of the invention is to provide a variable speed transmission mechanism arranged to permit the operator to quickly and easily change from one speed to another without danger of stripping gear



A PLAN VIEW OF THE VARIABLE SPEED TRANSMISSION MECHANISM

wheels. Another object is to provide a large number of different speeds, say ten for forward drive and five for reverse drive, thus permitting a gradual instead of an abrupt change from high speed to low speed or vice versa thereby rendering it possible for the engine to maintain a practically constant speed.

MEANS FOR LUBRICATING MACHINE TOOLS.—W. F. MCCARTY, Defiance Machine Works, Defiance, Ohio. The object of the invention is to provide means for lubricating the drill spindle, the driving and feeding mechanism for the drill spindle, the speed changing mechanism, and simultaneously supplying lubricant to the drilling tool in the work on the work bed. Another object is to insure a continuous feeding of the lubricant, and to permit of using the lubricant over and over again, thus reducing the waste to a minimum. A further object is to permit the use of a completely closed casing to prevent dust and accidents from the moving parts.

## Medical Devices

MEDICAL APPLIANCE.—W. J. DOYLE, 5804 17th Ave., Brooklyn, N. Y. Among the objects of the invention is to provide a medical applance especially adapted for use by bedridden patients, such device being secured in operative position without liability of becoming displaced, or the contents of the receptacle being spilled, but which may be readily cleaned, thereby making the same sanitary in every respect.

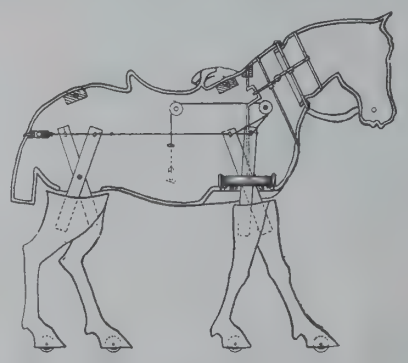
RUPTURE PAD.—T. PACHALI, SR., 232 No. 10th St., Reading, Pa. An object of the invention is to provide a pad which comprises two members movable toward each other to exert a pressure on the tissues. A further object is to provide a pad which can be utilized to grip the flesh directly or a covering or portions of the clothing over the same, and which will retain its position after adjustment. The device may be utilized in connection with any approved form of belt.

## Prime Movers and Their Accessories

SPARK GAP CONTROLLING DEVICE.—G. H. TABER, 182 State St., Binghamton, N. Y. This invention relates to sparking devices for internal combustion engines or the like, and has particular reference to means for varying the intensity of the spark by positive means under the control of the operator. The primary object is to provide means whereby the gaps in all or any number of spark circuits may be increased or diminished at will and so maintained either during the starting of the engine or its subsequent operation.

## Pertaining to Recreation

WALKING TOY HORSE.—A. H. LOOMIS, Les Cruces, N. M. This invention relates to amusement devices and has for its object to provide a toy horse with means whereby its legs may be moved by an operator seated upon



A LONGITUDINAL SECTIONAL VIEW THROUGH THE DEVICE

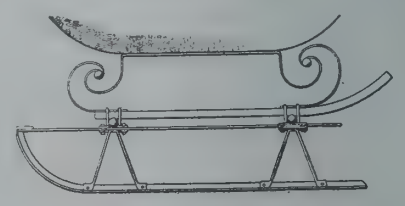
the horse whereby the device will progress with a walking action. An important object is the provision of a toy horse in which the head is swingable laterally to effect steering, connection being provided between the head and the front legs whereby they may be turned without interfering with the walking action.

MARBLE SHOOTER.—A. E. MADISON, 118 Myrtle St., Redlands, Cal. This invention while capable of discharging various projectiles for different games is more particularly intended for embodiment in a device for shooting the taw in playing marbles. The general object is to provide a shooter presenting a seat for the article to be projected and provided with handles to be grasped for holding the shooter and a spring for exerting a projecting force, together with means to contol the spring and to release the same for the projecting movement.

## Pertaining to Vehicles

SHOCK ABSORBER.—T. DAVIS, R.F.D. No. 1, Mounds, Okla. Among the principal objects of he invention is to provide a shock absorber so constructed as to resiliently suspend the springs of a vehicle in such a manner as to relieve the springs of a portion of the road shocks, by the provision of a device wherein compression and rebound occur without danger of breaking the vehicle or the shock absorber springs.

SLEIGH RUNNER ATTACHMENT FOR VEHICLES.—B. FISCH, 403 Chester St., Brooklyn, N. Y. The object of the invention is to provide an inexpensive attachment for vehicles,

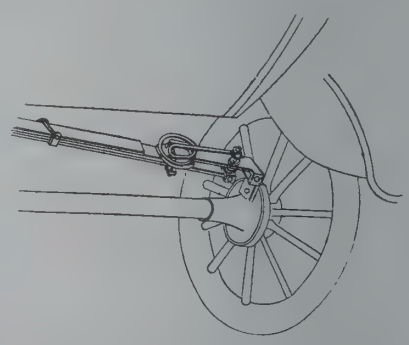


A SIDE ELEVATION OF THE DEVICE, AS ATTACHED TO A BABY CARRIAGE

especially baby carriages, having two runners with means by which they may be quickly and easily mounted on the axles of a vehicle and be secured in position relatively thereto.

TIRE PROTECTOR.—L. F. PETEY, 324 Lincoln St., Rhinelander, Wis. The invention has for an object to provide a construction wherein the resiliency of the pneumatic tire is retained while a thorough protection against puncture is secured. Another object is to provide a protector formed into a plurality of parts and connected together in such manner that it will not interfere with the usual resilient action of the tire.

SHOCK ABSORBER.—T. DAVIS, R.F.D. No. 1, Mounds, Okla. This invention relates to attachments for motor vehicles and has for its object the provision of a shock absorber for use upon motor vehicles of a very popular make provided with transverse front and rear springs, the device being in the nature of



A PERSPECTIVE VIEW, SHOWING THE DEVICE AS APPLIED TO ONE END OF THE REAR SPRING

a coil spring including a plurality of horizontally disposed convolutions, novel means being provided for connecting the device with the rear hubs or with the front axle as the case may be.

RIM HOLDING STAND.—P. CANNON, 36 W. 66th St., New York, N. Y. The invention relates to means for facilitating the removal of a shoe or tire from a rim and more especially to a device particularly adapted to be used with a rim of what is commonly known as the detachable, demountable type. The object is to provide a foldable rim holding stand arranged to support a rim a short distance above a floor to facilitate the removal of the shoe, the device being readily adjustable to accommodate different sized rims.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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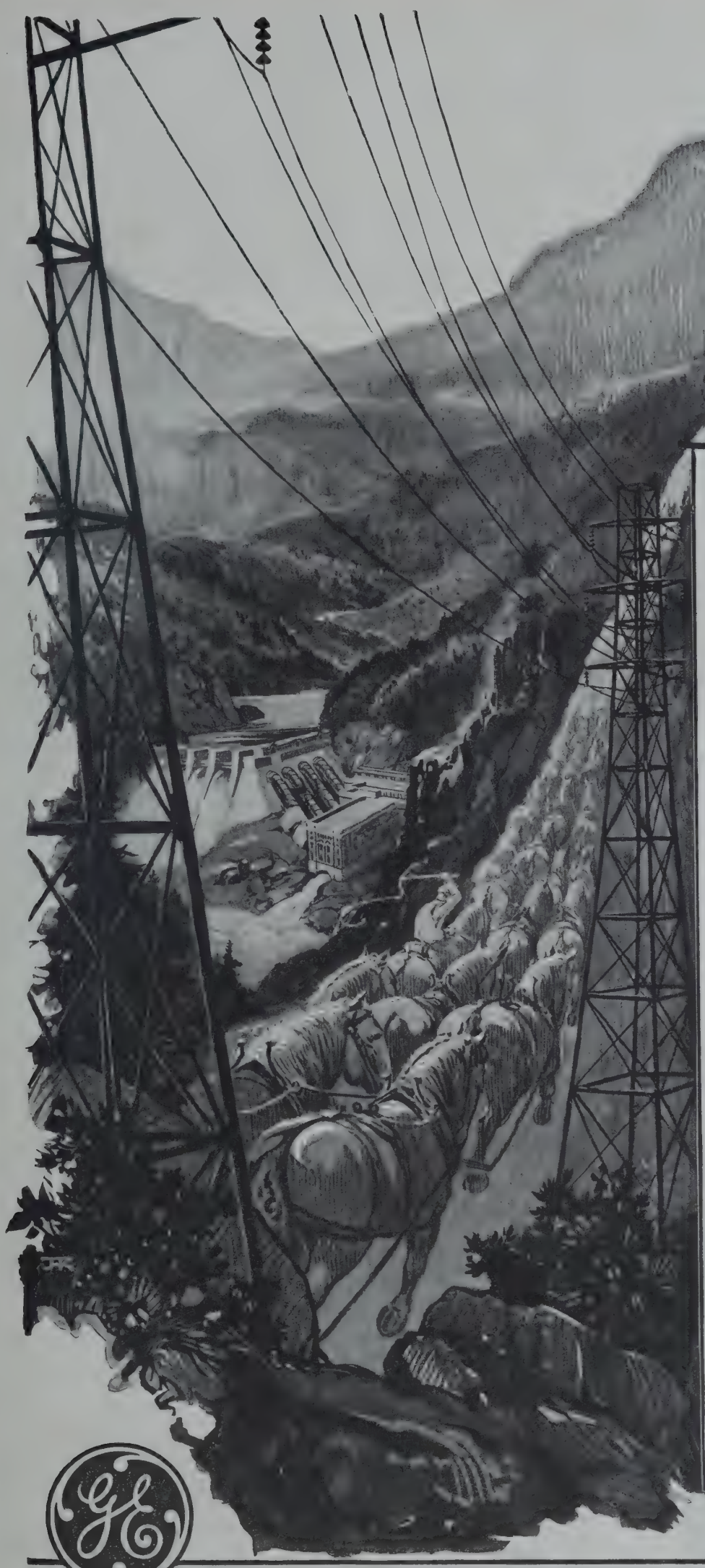


## *Sending horse-power world-wide through a wire*

AT six o'clock in the evening a switch is closed and the streets of Los Angeles become broad avenues of light. At the same time, a little village a hundred miles away is made safe for the night by the glow of electricity. And the same source of power supplies them both.

Far up in the hills is a power plant, where big smooth running machines silently change the rush of a waterfall into the invisible power that runs through a wire and does the work of man *wherever he needs it, whenever he wants it, no matter how hard that work may be.*

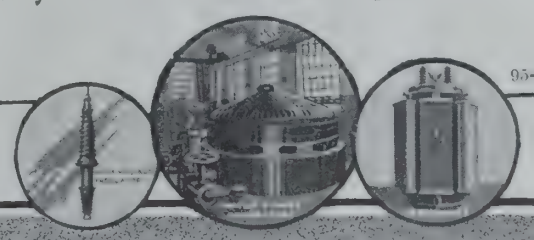
Whether it be to drive the wheels of big industry, to carry people and materials across continents, to propel a ship at sea, to save the housewife work and worry, or to furnish the same good light for the rich and poor alike—electricity is always available, for it can be carried from the place it is made to the place it is used, quickly, cheaply, safely, in any amount.

The same system of wires may be fed by a coal mine in Pennsylvania and a waterfall in Maine, and may supply a power line which serves a spinning mill in Massachusetts and the water pump of a Delaware farmer.

The people of several states derive benefit, pleasure and protection from one power plant on the Mississippi at Keokuk, Iowa. The falls of Niagara serve thousands of communities in New York State and Canada.

The General Electric Company has not only provided a means for developing nature's dormant resources into power. It has also perfected the necessary machines and devices for sending that power to the places of greatest usefulness. These machines regulate the intensity and pressure of that power; protect the lines from lightning and make it easy to distribute 50,000 horse-power in fractions of a single horse-power, without danger to equipment or user.

But the greatest service of the General Electric Company is its increasing usefulness, both in the origination of new machines for new uses, and in the whole-hearted employment of its vast organization towards making electricity a commodity which may be made cheaply, transmitted easily and used intelligently by the masses, from school boy to engineer. And in doing this, the General Electric Company is constantly striving to conserve raw materials, such as fuel, which may better serve man in other capacities



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GENERAL ELECTRIC COMPANY

# Jim Wanted to Earn More —

Jim was the "belt man" at the Millard Mills.

Ambitious enough to want to see more money in his pay envelope each week. Yet *intelligent* enough to know that to *get more*, he must make himself *worth more*.

And just there was the "rub."

Kept on the jump every minute of his working day—rushing hither and yon to *remake* belt joints that didn't, wouldn't and apparently couldn't "stay put"—Jim found little or no time for really constructive work—work that would have increased his earning power and his *getting* power. He was in a rut—and he knew it.

It was then that he heard of Crescent Belt Fasteners—heard how they dispelled belt troubles once and for all by making a joint that "stayed put."

Jim was incredulous—but desperate. He determined to give Crescents a trial. Did so. Found that what he had heard was Gospel Truth. The joints he made with Crescents H-E-L-D with a won't-let-go grip. No part of the belt was punched or cut away—its full strength was sustained. Perfect contact with pulley at the joint insured full power transmission. Freedom from the interruptions caused by non-holding joints meant continuous production.

And now Jim is a different man.

Freed from the worry and work of continually remaking belt joints, he has time to apply himself to productive, constructive work—to make himself *worth more* to Millard Mills.

Furthermore, the Big Boss has noticed the difference in Jim. And has made a corresponding difference in the amount he puts in Jim's weekly pay envelope.

Is there a moral in this for you?

If so, we suggest that you write to Dept. 66 for new Booklet on Increasing Belting Efficiency

**CRESCENT BELT FASTENER CO.**
**381 Fourth Avenue, New York**
**Canadian Branch: 32 Front St., West, Toronto, Canada**

**CRESCENT BELT FASTENERS**
*"Make Good Belts Give Better Service"*



FORGING AHEAD

IN the acquisition of the Chicago, Ill., and St. Catharines, Ont., works of the Whitman & Barnes Manufacturing Co., J. H. Williams & Co. attain the ultimate geographical ideal for the service of their customers in Superior Drop-Forgings and Drop-Forged Tools.

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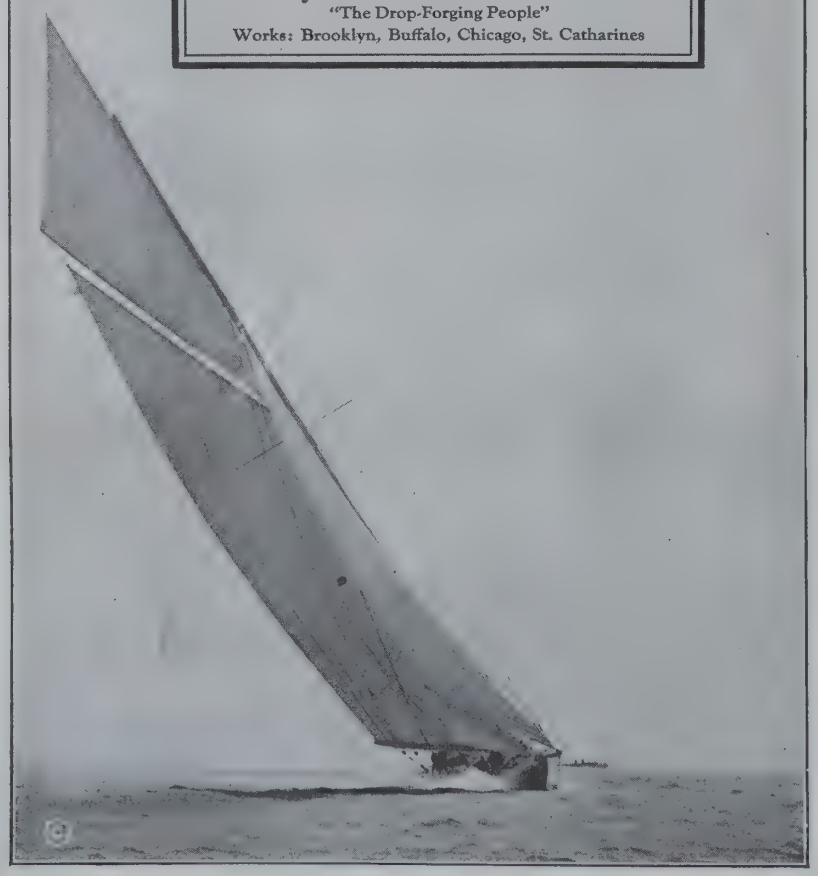


## Fish Fancying and Freak Farming

(*Continued from page 31*)

their fate and never revisits the spot.

With the approach of cold weather, the adult terrapin begin to get inactive and ultimately burrow into the mud and hibernate until warm weather again rolls round. Left to themselves, these turtles hibernate in deep water or in holes which they dig along the shore a few inches under the low-water mark. Where the turtles are raised in confinement the customary practise is to provide a board shelter which is sunk and fastened to stakes about one foot above the bottom of the pound in some protected corner of the inclosure. Generally the fish shed is bedded with eelgrass, a shelter three by five feet in size furnishing ample bedroom facilities for the winter sleep of 100 to 200 full grown turtles where they arrange themselves in layers, as they ordinarily do.

It is a relatively easy and simple matter to care for adult terrapin while their feeding expenses are practically negligible as it only costs seven to eight cents a day to feed 100 animals. Under natural conditions, the diamond-back terrapin is omnivorous, feeding on smaller crustaceans and mollusks and consuming, in addition, considerable vegetable matter. Under domestication, chopped, fresh fish is one of the best foods for the aquatic turtles, the average adult consuming about two ounces daily. Blue crabs or fiddlers may be used as a change feed to lend variety to the menu where they are available while oysters are the preferable food for the young turtles which are forced during the season of cold weather in the hothouse. The common practice is to feed unmarketable and small-size fish to the terrapin. Under conditions where a dependable supply of fresh fish was not obtainable, cornmeal has been fed in a soft mash form while sliced and mashed cabbage and turnips have also been successfully used.

Terrapin farming features two avenues of income, as foundation breeding stock can be sold to persons who wish to engage in the business in addition to marketing the mature turtles for human consumption in Baltimore, Philadelphia and New York, the leading terrapin centers of the country. As the annual losses consist of less than ten per cent of the first brood and a mortality of less than one per cent a year in the case of the full-grown terrapin, the income from the commercial production of these valuable and sought-after products promises to be fairly certain and dependable. It is essential to keep the pens and pounds clean and free of contamination. Usually the water flow will carry away any debris and where only chopped fish is fed there ordinarily is no aftermath left to be removed. It is necessary to maintain the winter house for the young in a neat, sanitary condition and where these requirements are satisfied, the terrapin raised under confinement are protected from all the evils and ailments to which the animals are exposed under natural conditions with the results that sickness and mortality are reduced to a minimum.

## The Twentieth-Century Lumber-Jack

(*Continued from page 34*)

These are driven into the cut, back of the saw. They keep the tree above from throwing weight on the saw and thus causing it to "bind" and they also assist in directing the fall. After a time, there comes a critical moment when the tree really starts to fall. This occurs when a part of the bole is still untouched either by notch or by saw cut. The sawyers must be on the alert. It is necessary to stay long enough, and it is inadvisable to stay over long. One man simply lets go and makes his "get away"; the other must get the saw out and then get out of the way.

Before quitting the felling of trees, it may be of interest to show how the lumberman uses peavey and kilhig in directing the fall. The kilhig is a long pole, perhaps 3 or 4 inches in diameter. At one end it is sharpened or else shod with a pointed tip or fitted with a spike. This end is set in a small notch in the tree at a point anywhere from 5 to 8 feet above the ground; while the other end rests against a peavey handle or short pole. The peavey or pole is stuck in the ground like a crow-bar and is in contact with the kilhig a short distance above this point of support. By thrusting the upper end of the peavey or pole forward, the whole acts as a lever, the fulcrum being at the ground level. By this means a very strong thrust may be exerted against the kilhig and so against the bole of the tree.

The great tree may be comparatively alone so far as big companions are concerned; but there may nevertheless be quite a woods around. He crashes down, woods or no woods, crushing and breaking everything in his way. His branches are to be cut away and his bole cut into log lengths. This latter is called "bucking" the tree. Here the cross-cut saw has largely displaced the axe.

The cable-way is coming into greater and greater use in logging operations. Its principal function at present is concerned very largely with the getting of the logs from the scene of the felling to points along the road over which they are to be hauled. Essentially, the cable-way consists of a sufficiently heavy wire rope temporarily suspended between elevated supports, a carriage adapted to travel on this rope as on a track, and sheaves and tackle suited to shift the empty or loaded carriage along the cable. This cable needs to be a strong affair as it must ordinarily support the log or logs. A wire-rope 1 or 1¼ inch in diameter is the usual thing. The span may be 600 or 750 feet, or even longer. A representative method of arranging matters is as follows: Along the road over which the hauling is to be done, and at intervals of perhaps 1,000 feet, head trees are selected. Back in the region to one or both sides of the road, tail trees will also be chosen. Intervals between them of 150 or 250 feet are representative. These tail trees will roughly parallel the road and the line of head trees. A cable-way will cover the ground between a tail tree and the nearest head tree. It will readily be seen that in some positions, the cable-way will be perpendicular to the road and at other times more or less oblique. The logs are secured, naturally, in the regions commanded by the cable-way positions and brought in to the head trees by operating the carriages.

The head trees are selected for size, height and straightness as well as convenience of position. A good head tree may be 18 inches in diameter 60 feet from the ground. Steel guy ropes are used as a means of maintaining head and tail trees. It is necessary that the carriage or trolley shall have two movements—the out-haul and the in-haul movement. Two independent ropes may provide for this double requirement. A hoisting engine will be set up near the head tree. For two independent ropes, it must provide two independent drums or their equivalents. The tail rope may be arranged as follows. It passes from the hoisting engine to a sheave block secured up on the head tree, thence to and through the carriage and on to a second sheave up on the tail tree. Passing round this sheave, it returns to the carriage and is there attached to the rear of it. Naturally, a winding-in movement of the drum will exert an out-haul pull on the carriage. The in-haul rope is known as the skidding rope. It runs from a drum on the hoisting engine to a sheave up on the head tree and thence to a

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second sheave secured to the head of the carriage. This rope may then run back to the head tree. A winding-in movement of the drum, and the trolley is hauled in with its load. The power of the skidding haul may be regulated by the windings on the blocks. Naturally, though, the greater the power exerted thus, the slower the speed. But it is, in mechanical affairs, often the case that what really counts is doing the work whether the speed be slow or fast.

The aerial tramway is a kind of developed cable-way. It is advantageously used in such cases as those where the logs are to be got off of a plateau to some comparatively low point in the valley; and in cases where a reverse transfer is to be made—that is, for example, from a wooded region in a canyonlike valley to some elevated point on the side. In either case, what needs to be done is not necessarily a transportation from the scene of the felling nor a transportation to a main road to the mill. The bridging of the gap, as it were, may occur at any place between the point where the trees grew to a point where they are cut up into lumber. Generally, the tramway lies in one vertical plane. But there may be curves in that plane—depressions and elevations. If the general direction is down, gravity may supply the power for the transportation. The logs are carried, not dragged. Tramways may be quite long affairs. There is one in the South that is 3,700 feet in length. The logs are brought to the brow of a plateau by other means. From this point to a railway in the valley below, they are transported on the ¾-inch steel rope of the tramway. The general slope of the country is followed roughly by the line traced out by this cable in a vertical plane. There are brackets at intervals of 150 and 250 feet which support the line and are in turn supported by the trees to which they are attached. There is a suitable casting belonging to the brackets, and a slot in this casting provides a resting place for the wire rope. The logs are carried by trolleys, two to a log. The cable rested in a slot in the casting without being fastened, except in depressions, where a keeper was secured to the bracket. Each of the trolleys carrying a log was provided with two sheave pulleys. These ran on the upper side of the cable. The logs were secured and held by "grabs." Each grab was attached to a short chain at one end, while at the other a ring was provided. The rings enabled the chains, grabs and logs to be temporarily secured to the two trolleys. Five pairs of trolleys carrying five logs were secured together by a ⅜-inch wire rope which passed around a drum controlled by a friction brake. Naturally, the hoisting engine to which the drum belonged was set up at the head of the incline. It paid out the line connecting the trolleys when they made the descent to the railroad, and wound it in when the load had been discharged and the trolleys and chains were ready for the return. A 15-hp. gasoline engine supplied the power. The logs were brought to the brow of the plateau by horses, after which they went down the inclined cable. This example will answer as sufficiently representative of the use of cable tramways in logging operations. Variations may naturally be made, even to reversal of the direction of movement of the load.

Logging railways have been coming into favor in recent years. These vary much in design, excellence, speed of transportation, and the like. Some roads have tracks whose rails are the natural boles of trees. The limbs are removed and the inner face squared. Such rails may be laid directly on the ground if it is sufficiently hard, although a certain amount of ballasting or blocking up may be needed to get the upper surface moderately level. The motive power consisting of horses, mules or oxen, goes on its feet in the space between rails. After a time

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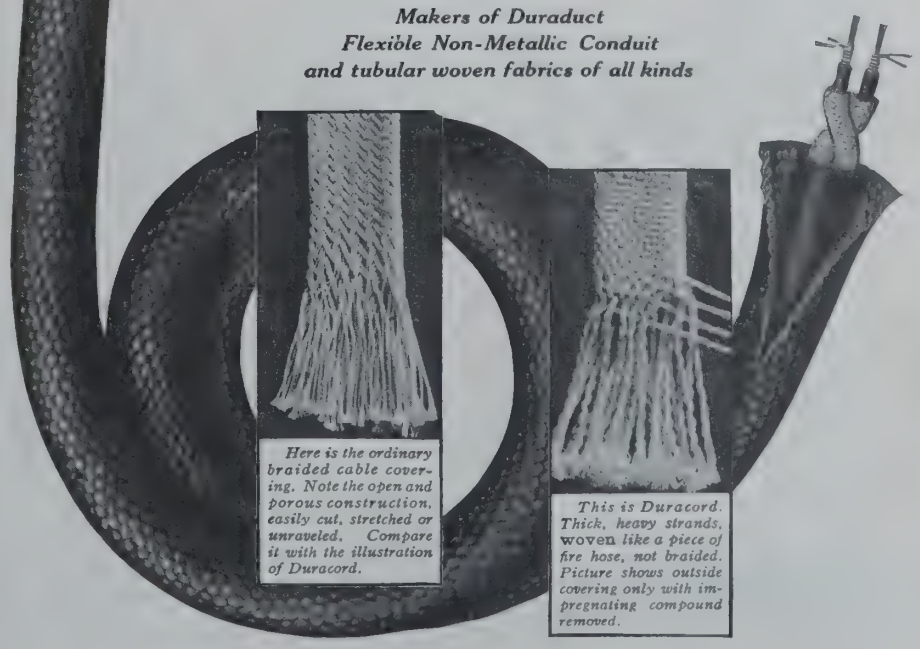

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such a railroad may become a kind of shallow trench through the woods. The wheels of the cars may have big circular grooves on the periphery to provide for a proper grip on the rail; or the inner flange may be more pronounced. Then there are railroads where sawed pieces supply the rails. This particular type of road is common in the hardwood regions of the Appalachians. However, the cost of maintenance is considerable, due largely to the wear and tear of the rails, but also to the disintegrating effects of wet weather. Steel rails are in considerable use and have approved themselves over a goodly period. Railroads with such rails may be operated by animal power or by steam locomotives.

### Turning the Wheels of a Century Hence

(*Continued from page 36*)

the country or for a drainage basin. Furthermore, different authorities show a wide variation even for comparatively limited areas. For instance, one authority allots to California 11,400,000 horsepower, another only 5,000,000. One authority gives Oregon nearly 9,000,000 horse-power, another only 3,300,000. One gives New York, Maine, California, Oregon and Washington a total of 31,000,000 horse-power while other authorities give these states a total only half as great.

There are comparatively few distinctively storage developments in the United States. In many engineering problems the engineer can use the actual results of similar work as a basis for estimates, but in computing storage possibilities few if any such results are available. Any estimate including storage, therefore, must be mainly theoretical. Such theoretical computations are likely to give results far in excess of actual possibilities. There are many practical factors that reduce such theoretical power. In the first place, the flow of many streams so fluctuates—that is, the flood is so high and the minimum so low—that a vast storage would be necessary to bring about a reasonably high average of actual power-production. Such storage may be either physically impossible or its cost may be prohibitive, because of the value of the land which would necessarily be submerged. The New York State Water Supply Commission, for instance, found that the flow of the Delaware River varied from as little as 400 cubic feet per second in extreme drought to 150,000 cubic feet at freshet flow, but that there are not storage facilities of sufficient capacity to hold back the vast volumes of flood water. Again, a stream may have a relatively even flow but so gentle a slope as to render storage impracticable; and still again, power and storage developments may be impracticable because of insufficient foundations for a dam. This is the case with the lower portions of the Grand and Muskegon Rivers in Michigan. Storage possibilities are further limited by the increasing demand for water for other uses, such as irrigation and domestic supplies for cities and towns. It is apparent, therefore, that any estimate based largely upon the theoretical possibilities of the topography of a section must be subject to serious practical error.

Summarized, then, the conclusions here reached are that the maximum possible power-development through the use of water power is but a wild guess, but that it is most certainly in excess of twenty-five million horse-power, that it is probably in excess of forty million horse-power and that it is possibly more than double that sum, should great need (as caused by a fuel shortage) make an intensive cultivation of water power a necessity as well as an economical possibility.

With these figures in mind, we can logically proceed to a consideration of those factors which have held this nation back in the development of its water power and the necessary things we, as a nation, must do to make of our power resources as great an economic asset as we have made of our coal and are now making of our oil. Let us hope that when we do, it will be with less waste and extravagance than has characterized our use of fuels, and let us thank whatever Gods control us that our power resources, unlike our forest resources cannot be destroyed by fire or greed for the present gain without regard to the future.

### Measuring Steam

(*Continued from page 37*)

that it is usual to magnify the motion of the mercury by a float and pulley mechanism, thus giving a large motion of a pointer exactly as in the case of the ordinary type of "weather glass." Another device consists in arranging that the column of mercury as it rises shall successively short-circuit a number of resistances through which a current of constant voltages is flowing. By suitably proportioning the resistances it is possible to arrange that the quantity of current flowing at any time is directly proportioned to the quantity of steam flowing. Thus an ordinary ammeter will serve as an indicating instrument, and a wattmeter similarly can be used for recording the total flow. The use of mercury, however, has certain disadvantages, so that other makers cause the differential pressure to act upon a spring-controlled diaphragm, the movement of which is magnified and transmitted to the pointer by means of a series of levers.

In some steam meters diaphragms, similar to those used in aneroid barometers, are employed, and the pressure correction device to which reference has been made above consists of another set of spring-controlled diaphragms subjected to the total steam pressure. The motion of these latter diaphragms is made to alter the leverage with which the differential pressure diaphragms act upon the pointer. The combined action of the two sets of diaphragms therefore causes the pointer to indicate the true quantity of steam which is passing, independently of changes which may take place on its pressure. In addition to recording the rate of flow on a chart these meters may be caused to integrate the quantity of steam which has passed, so that it may be read directly on counting dials. The clockwork mechanism which drives the chart also causes the periodical rotation of a spindle, which is held in gear with the counting mechanism during a part of the revolution, greater or less according to the rate of flow at the time. Other methods of integrating the flow comprise a friction wheel driven by a disk. The disk is rotated uniformly, but the revolutions of the wheel and therefore of the counting mechanism depend upon the radial position of the wheel on the disk. This position is controlled by the rate of flow of the steam.

### Toys That Do Great Work

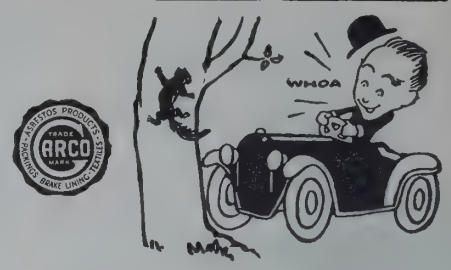
(*Continued from page 38*)

recorded. It is possible to calculate from this test just what horse-power will be required to drive the completed ship. In the case of yachts or other pleasure boats, the designer often has made a model which will show the prospective owner just how the vessel will look.

Before a skyscraper is built or any other important building, plaster or clay models of it are made to assist the architect in designing the exterior. Interior models are also often made to help in the arrangement.

Models were used in the laying out of some of our huge war munition plants. In one case a model almost large enough to fill a room was made, with every building in detail. It facilitated the problem of arrangement.

Since 1912 the U. S. Naval Academy has used hundreds of models for the instruction of cadets. One model built for the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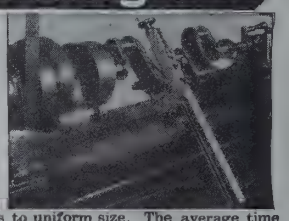

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It has been found that by the use of models instead of drawings or photographs the task of explaining a mechanism to the student is much simplified. Other nautical schools and in fact, schools of all kinds, have followed the lead of the Naval Academy in using models.

The motorist now can buy models made of cardboard and metal which show him the exact function of every piece of his motor car. In fact, any attempt to catalogue the varied practical uses to which models are put must end in the approved sale-bill style "and other uses too numerous to mention."

The foregoing names some of the more important uses, but overlooks perhaps the most common—that of employing models in the developing of patents. The U. S. Patent Office formerly required that a model be submitted before patent papers were granted. But this practise was discontinued after thousands of models had accumulated and finding storage space had become a problem. But every American citizen over the age of ten years has tucked away somewhere a model of "my invention."

## The Mechanical Hello Girl

(*Continued from page 41*)

scriber it is ready to receive his order by giving him a distinctive buzz called a "dial tone."

As the next step in the manual operation the calling subscriber gives his order verbally to the operator. In the mechanical system the calling subscriber dials his order to the sender by pulling the letters and numerical digits of the number desired, in succession.

Assuming that the call is for another subscriber in the same office, the manual operator gives the desired number to a "B" operator in her own office over the call wires, gets a trunk assigned and extends the calling line to the "B" operator by plugging the calling cord of the pair she has used in answering into the outgoing trunk leading to the "B" position. The mechanical "sender," upon receiving the office code letters from the subscriber dial, recognizes their significance and causes the "district selector" (elevator), which is definitely tied to the line finder previously used, to start up and select an idle path or trunk leading to an "incoming selector" (elevator) in the same office. The analogy is evident between the "calling cord" of the manual system and the "district selector" of the mechanical, as well as the manual outgoing trunk multiple jacks which terminate at the "B" operator's position to the district selector banks which terminate incoming selectors on the incoming frame.

The "B" operator locates the desired subscriber's number in the multiple before her by first locating the hundred, then the strip, then the particular line. She then tests the line to see if it is busy. If it is not she inserts the incoming trunk into the multiple jack and ringing is started automatically. If the line had been busy, she would have inserted the trunk plug into a "busy back" jack. The mechanical step corresponding to all this is when the "sender" causes the incoming selector to locate the group of trunks leading to the particular 500 lines in which the desired number is located. This causes a non-busy trunk to be selected and then causes the "final selector" (elevator) on the end of that trunk to locate the hundred, then the ten and finally the particular unit line desired. The "final selector" tests the line to see if it is busy, and if it is not establishes the connection. Ringing is started automatically. If the line is busy the connec-

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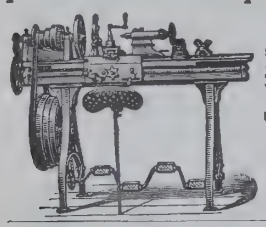

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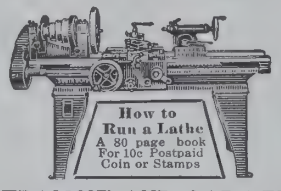


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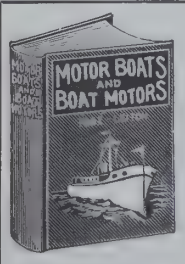


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THIS is a complete handbook for all interested in any phase of motor boating, as it considers all details of modern hulls and marine motors, deals exhaustively with boat design and construction, design and installation of all types of marine engines and gives expert advice on boat and engine maintenance and repair. Not only is boat construction fully treated but every needed dimension is given for building from complete, yet simple plans and construction is considered step by step. Everything from the selection of the lumber and laying out the boat molds to the finish of the completed craft is outlined in detail. The boats described have been built by the author and the plans are right. The book has also

A Special Chapter on Seaplanes and Flying Boats

SCIENTIFIC AMERICAN PUBLISHING CO., 233 Broadway, New York


tion is not established and a "busy signal" is sent automatically back to the subscriber. The analogy between the subscriber's multiple on a manual "B" board and the combination of the incoming and final frames, while not perfect, is still rather striking.

No attempt has been made here to describe the intricate machinery which accomplishes the remarkably human results. They represent years of work on the part of many trained engineers and it would take volumes to describe them adequately. Neither has it been explained how all of the supervising, timing and ticketing of various classes of calls is accomplished. It must suffice, in the limited space available, to say that it is done and with much less error than occurs when these same operations are performed by human hands and brains.

While other improvements will undoubtedly add to the utility and economy of the automatic telephone, the instrument has now reached a stage of perfection where the large telephone companies are willing to invest millions in such equipment, and have already begun installations which will eventually cover the entire continent.

Of course most of these momentous changes will go on so gradually and with so little friction that the average man will not realize their significance. He will have his desk phone equipped with a dial and he will find the telephone numbers in the directory listed with the first three letters of the exchange name in capitals. He will find his service better, but he will take it all for granted and will worry his head very little over how it's done. But to the man who takes the trouble to investigate, this new development in modern science will be a never-ending source of wonder.

## The Rôle of Asbestos

(*Continued from page 42*)

contaminate the original composition of the fluid.

Asbestos has a very wide adaptation in the automobile field, for, in addition to the already enumerated uses, which are of course found for it in automobile factorise as well as elsewhere, it is used in wood form for the construction of enameling ovens and in other places requiring a structurally strong fire- and acid- proof material. Asbestos is particularly valuable in the actual operation of the automobile itself, as a gasketing material for cylinder heads and intake and exhaust manifolds; as spark plug packing, clutch facings and protective tubing for the electrical wiring; and in some cases in the manufacture of the tire fabric. Then the greatest use of all for asbestos in automobile operation is for brake-band lining, the production of which is approximately fifty million feet per year. The longest fibers are required for brake band lining and textiles. On account of its high coefficient of friction and resistance to heat and wear it is also chosen for brake drums on hoisting-engine cranes and like apparatus.

The familiar uses for asbestos in the home are the insulation of furnaces, steam and hot water pipes, hot air ducts and as a stove lining; as table covers, table mats, flat-iron holders and rests and fiber for gas logs; as a fireproof material for ceilings, walls, partitions and baseboards; and as stucco or roofing for the home, barn, silo or garage.

A list of the possibilities of asbestos is far from being exhausted by packings and heat insulations in the industrial field. The architect and engineer are further indebted to it for the safer, better and easier construction of fireproof buildings which its use in the forms of asbestos wood or "lumber," waterproofing felts and roofings has made possible. The variety of present uses in the building of business structures and homes indicates the almost unlimited range of possibilities for this mineral in building construction.

Asbestos wood is remarkable in many ways. It is comparatively light in weight; structurally strong and practically everlasting. It can be "worked," fastened and painted like ordinary woods but unlike them it does not warp or crack in service. It is all the more remarkable because of the positive fire-protection it affords with a minimum thickness—as against brick tile and other materials—thereby saving valuable floor space. It is widely used as a fire barrier in walls, partitions, doors and ceilings in hospitals, libraries, depots, public buildings, residences, foundries, warehouses, machine shops, garages and almost every other type of building. In this application it takes the form of roofing, sheathing, window casing, moldings, cabinets, tank linings, flooring, and battens. For electrical purposes asbestos wood plain or impregnated is less absorptive, has greater dielectric strength, is lighter in weight, has greater insulation resistance, and is structurally stronger than competing materials; it will not crack under the highest voltage.

Asbestos is recommended for use as disconnecting switch bases for lightning arresters; primary fuse boxes; terminal blocks on motors and generators; panels for switchboards; switch barriers; faces for all kinds of rheostats; electric elevator controls; cabinets for distant control of oil switches; converter panels; busbar supports; and for many other places in the manufacture and uses of electric equipment.

Next to the heat-insulating and packing field the greatest use for asbestos is in the manufacture of fireproof roofings and shingles. Its inherent durability and immunity to fire and atmospheric conditions make it the ideal material for this purpose because of the protection from roof-communicated fire it affords both the individual and the community. The standard forms of asbestos roofings are, first, asbestos shingles, composed of asbestos fibers and Portland cement pressed together and cut to size and shape, and invariably used in the construction of homes and residences. Then there is asbestos felt roofing, made of asbestos felts cemented together with asphalt and shipped in rolls, and used both as a roofing material and in waterproofing the foundation walls of industrial and office buildings and similar structures. Finally, corrugated asbestos roofing, in which the asbestos felts are cemented to both sides of a sheet of corrugated steel to serve as a protection against rust and corrosion, is used on foundries and industrial buildings over skeleton frame construction as a roofing and siding.

Even in the theater asbestos is absolutely essential. In the curtain it serves as an armor against fire and the dangerous backdraft. Scenery is made from asbestos and the lights, both in the theater and home, are energized from distant generators through a system safeguarded by this same material. In the moving picture theater, which today is a recognized part of our social life, the patrons are protected from the spread of fire from the inflammable film by an asbestos-wood projecting booth. At the warehouses of the film distributors these highly inflammable films are stored in racks and cabinets made of asbestos wood.

Asbestos today is an industrial, architectural and domestic necessity in the strictest interpretation of that word. There is no substitute for it. No other known material possesses the inherent fire resistance, durability and adaptability of asbestos. It can be woven, spun, pressed, matted, molded, in fact made up in almost any form, either alone or in combination with other materials to produce the desired results. And what is very important, it readily combines with almost any material because it offers no chemical or physical reaction.

05
SA
Engineering

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

DOWN THE WIND WITH EVERYTHING SET.—[See page 64]

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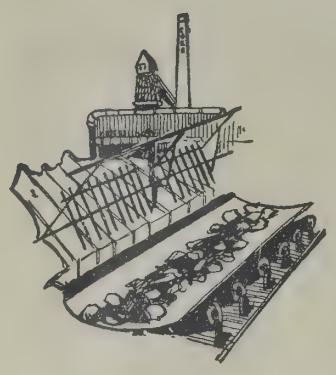
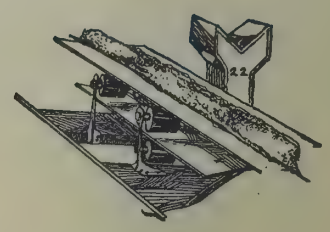
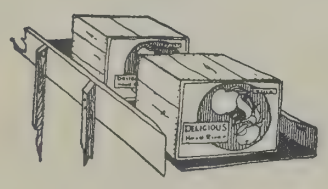
# "Convey by Belt"

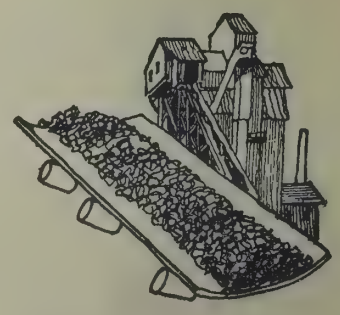


THE progressive man does not transport his raw material or finished product by wheelbarrow or hand when railroads or motor trucks are available.





Yet within his own plant there are relatively short hauls where conveyor belts can handle materials in greater volume and more economically than hand labor.



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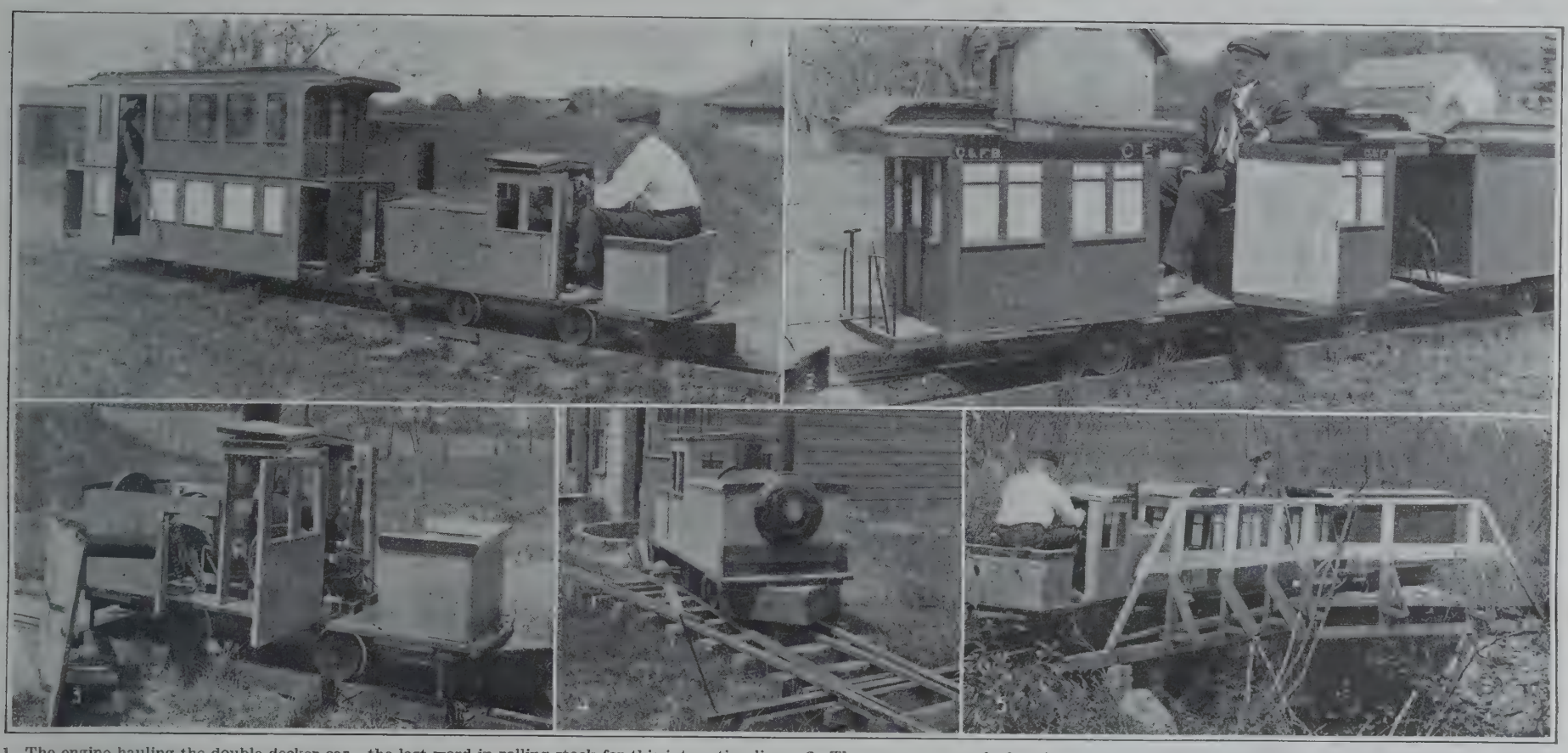
SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 3 ] NEW YORK, JULY 17, 1920 [ 15 CENTS A COPY $5.00 A YEAR



1. The engine hauling the double-decker car—the last word in rolling stock for this interesting line. 2. The passenger cars look quite like the real thing, but their interior arrangements are slightly different. 3. Showing some of the details of the locomotive, with its gasoline engine. 4. A one-car passenger train leaving the roundhouse. 5. A bit of rural scenery where the road crosses the brook.

**Toy railroad of much utility built as a hobby from old lumber by a New York farmer**

## A Tiny Railroad, at Once a Toy and a Tool

WHEN the city man sets himself up on the farm, either upon his retirement from active business or in connection with the establishment of a summer residence, he seldom confines his attention to mere farming. Something in the way of a side-line is bound to catch his fancy and lead him on until the farm itself has become more or less a side-line, while the original passing notion is the serious business of the estate.

Few gentlemen farmers, however, can boast a hobby as unusual as that of Mr. W. C. Gage, who a couple of years ago gave up his activities as a New York broker to enjoy the peace and quiet of his farm up the state. Mr. Gage found that the facilities for local communications between the several parts of his farm were not of the best. He also found that he had an abandoned chicken house about 250 feet long, which was thoroughly useless as a chicken house and in which the lumber was beginning to deteriorate. So he proceeded to kill three birds with one stone by using this lumber to renew the lines of transportation, and to have a bully lot of fun in the bargain.

The pictures show the miniature railroad—we cannot properly call it a play railroad because, while Mr. Gage plays with it a lot, it also does a lot of the serious business of the farm—at any rate, the pictures show what Mr. Gage made from his old hen house. He laid wooden rails to all sections of the farm, built a few tiny cars of various types, and set to work on an engine to pull these. It will be seen that while the engineers and the passengers occupy rather unconventional accommodations in the various units of rolling stock which make up Mr. Gage's equipment, these units are all got up, externally, to carry out the illusion of regular railroad stuff.

The locomotive is no dummy at all; it mounts a four-horse-power gasoline engine, which is ample to pull the cars at a decent speed over the rails which are supplied for the purpose. It is built for service rather than style, so the engineer has to imitate the oarsman and ride with his back toward the place to which he is going; but that is no great drawback. The passenger cars are capable of carrying two passengers each; and one double-decker car, with glass windows and all the other trimmings, is altogether de luxe.

Mr. Gage's road possesses, in addition to the passenger-carrying equipment, box cars and flat cars of ample size and in ample numbers to do all the hauling business of the farm, and to do it efficiently—in fact, he insists that his hobby justifies its existence in this manner. During the week he travels about the farm gathering up the produce and distributing manure and other necessaries; then on Sundays and holidays he totes the admiring visitors about in his miniature trains. Bridges, cross-ties, signals, and everything else that can add to the railroading atmosphere are to be found here—and all of wood, all home-made by Mr. Gage right on the spot.

## Stained Glass Once More in Vogue

ALL the valuable stained glass windows were removed from the large churches in Paris in order to protect them against air raids and destruction by long range gunfire, during the war. The windows were stored in safe places and remained unharmed. They are now to be carefully retouched and renovated and then to be reinserted. These windows total approximately 470,000 square yards of stained glass, and their renovating will take a long time and will be of considerable expense.

A wide and remunerative scope of work has thus been opened to the Paris Association of Glass Stainers, some members of which are noted artists. Although this association and some other guilds of glass stainers work entirely in a mediaeval craft it would be wrong to conclude that their methods are behind the times. Fifty years ago the old secret of staining glass, which was lost with the decline of art in the 17th and 18th centuries, was rediscovered and, with the aid of chemistry, has made remarkable progress. This is shown by the fact that today the glass stainer disposes of over 5,000 different pigments, while in the 12th century, the golden age of glass staining, only twelve colors were known.—By *J. E. Boos.*

## For Spark Plug Electrodes

THE use of cements for sealing electrodes into spark plug porcelain has been found to be attended by serious difficulties in high temperature engines such as airplanes. Among these are: promotion of oxidation and destruction of the electrode wires by reactions taking place in the cement and between the cement and electrode wires; breaking of spark plug porcelains caused by difference in coefficients of thermal expansion of electrode wires and porcelain, and cracking of cement, with consequent gas leakage, due to the same cause. A cement composed of silicate of soda and raw kaolin has been found to give little trouble from chemical action. In order to avoid the difficulties attending the use of any form of cement, the use of a mechanical seal at the top of the porcelain has been tried with promising results. Those interested are referred to Technologic Paper No. 155 of the Bureau of Standards, "Cements for Spark Plug Electrodes," which is now ready for distribution and any one interested may obtain a copy by sending a request to the Bureau.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## The All-Metal Monoplane

THE recent 1,400-mile non-stop flight on an all-metal passenger-carrying monoplane is notable, both because of the distance covered and because of the special design and materials of the machine. The all-metal monoplane has particular interest for this journal, for the reason that as far back as 1910, the SCIENTIFIC AMERICAN published its own design for a racing monoplane, built entirely of high-grade alloy steel. The article was inspired by a study of the highest types of airplanes of that period, as represented in the celebrated meet, ten years ago, at Belmont Park, all of which, including even the fast Bleriot monoplane, were so encumbered with wire and wood struts and ties, to say nothing of the elaborate landing gear, as to present a large and, as it seemed to us, unnecessary amount of head resistance. It was our conviction that by the use of steel construction throughout and by the adoption of the monoplane type, it would be possible to give the wings sufficient thickness for the insertion within them of transverse beams of sufficient depth to provide the necessary bending strength, thereby getting rid of all exterior trussing. The body of the machine was of oval cross section and streamlined, and in place of linen the wings and the body were covered with very light corrugated steel plating. The landing gear folded against the under side of the body when the machine was in flight, and automatic stability was secured by means of a compressed air cylinder, whose movements, controlled by a gyroscope, actuated the ailerons.

The suggestion was ahead of its day, but with the coming of the wonderful aluminum alloys that are now available, the design took practical shape, and toward the close of the war the Germans built some very successful monoplanes, which dispensed entirely with wood and linen fabric, depended for their wing strength on internal trussing, and were covered as to wings and body with thin corrugated aluminum plating. We believed then and we are still of the opinion that the fastest machines of the future will be of the monoplane type.

## The Scientific Basis of Sport

CONSTANTLY we refer, in speech and in writing, to the human mechanism and the human machine, or use some metaphor that draws analogy between the human body and the structure of metal, stone and wood. Often too we reverse the figure and speak of a machine that seems almost to be endowed with human intelligence. But when our little flight of rhetoric has served its purpose, we lapse back into a state of mind where we recognize that of course a man and a machine are two fundamentally different things. It were trivial to catalog the many distinguishing points that separate the human from the mechanical; but we may single out one of these points for purposes of adorning a tale.

We never design or install a machine of any consequence without considering carefully what it will do. Always there are understood to be certain things that a machine will do, and certain other things differing only in degree but which it will not do. It will travel 60 miles per hour but not 80. It will haul a load of 50 tons but not one of 75. It will turn out 10 tons of concrete mix an hour but not 11.

We go further than might necessarily appear on the surface of these remarks. We assume that under like operating conditions the machine will give like performances. We assume that if it will make 60 miles an hour today it will do the same tomorrow and next week and throughout its useful life. This may not seem to be an assumption—it may appear founded upon the immutable laws of cause and effect. But if we will compare the machine with the man on this basis of constancy of performance, we will see that we make an assumption, and a very material one, when we ask the machine to do a thing today merely because it did that thing yesterday.

As we write, Mr. Hagen has just lost out in his effort to annex the British golf championship. Four times he propelled the little white sphere over the landscape at Deal. Once he had to hit the ball 84 times to produce the desired results; again he required 82 strokes; twice he got around in 78—all over the same course. Duncan, the ultimate winner, on the second day negotiated the 36 holes in 143 strokes as against 160 which he used up the day before. No record of the occasions on which Hagen has turned in a better performance or Duncan a worse one is needed to establish the fact that what a man does today in golf, tomorrow he may repeat and he may not.

Again, as we write, Mr. Tilden has just taken unto himself the championship of the world in the game to which he devotes his attention—tennis. In doing this he had to defeat Mr. Parke, who had the day before beaten Mr. Johnston, who last year beat Mr. Tilden decisively for the American title. In the same tourney, Williams and Garland, on all performances of the past by far the weaker of the American teams, took the doubles title right out of the grasp of no less formidable a combination than Tilden and Johnston. On the basis of previous performances who would have dared predict all this? Who would be rash enough to assert that if the tourney were played over, the same results would be attained?

A couple of weeks ago the Brooklyn baseball club went to Boston for six games and lost five of these. They have just returned from a second invasion of the hub, during which they played and won four games. And because this morning's papers narrate how the club that represents New York in the other league scored 14 runs in a single inning against Washington does it follow that they will win the next time they face the same pitcher?

We have paraded these examples of human mutability from the field of sports because it is in the field of sports that we shall draw our moral. The fact remains, we can never predict that because a human being has done a thing he will do it again when he tries it again. The causes which contribute to a good or an average or a poor showing in any intensive human effort are so very many and so very complex that they defy analysis and prediction alike.

After all, isn't it better thus? Where would the zest and the competition in sport be if we could say "Well, A beat B last year, so B doesn't stand a chance against him now." There would not be any competition at all, except between "maidens," if we may borrow a term from the sport of kings. After a newcomer in any field of sport had met all the leading players, his place would be immutably fixed, and he could experience the real thrill of uncertainty, the real zest of competition where the result is at issue, only against other newcomers. So from the point of view of real sport, it is mighty fortunate that the human mechanism does not "run to form" like a true machine, and that constancy of performance is something to which no human can do more than achieve a rough approximation.

## The Folly of a Divided Fleet

WHATEVER political expediency there may have been in dividing our fleet between the Atlantic and the Pacific, from the standpoint of military efficiency, national defense, and economy, it was one of the most faulty moves ever made in the administration of the United States Navy.

A strong statement—but having behind it the Navy's greatest strategical authority; for in 1912, Admiral Mahan said: "To divide the battle fleet would be the most entirely suicidal act that could be contemplated."

The results of dividing the fleet are bad at best, and positively disastrous at the worst. In the first place, a divided fleet practically doubles the requirements for flagships, supply vessels, tugs, targets, flag officers and staffs, shore bases—in fact for everything which in business would be known as overhead expense. By combining the two fleets and reducing the ships and staffs now duplicated we should save several hundred officers, several thousand men, reduce Government expenditures by several million dollars and greatly increase the efficiency of the Navy.

Again, divided fleets develop doctrines and ideas independently of each other, according to the admiral in command. When the fleets come together for combined exercises, they do not readily amalgamate, for their training has differed. You could not throw the Princeton and Yale football teams together overnight and expect them to play an efficient championship game with Harvard the next day. Team work in a great fleet can be obtained only as a result of long practise. Neither half of a divided fleet is as big as the combined fleet would be in war. Therefore, during peace the Commander-in-Chief is not obtaining the training he should have in handling and maneuvering the large number of vessels that would be under him in war time. An occasional assembling of the two fleets under one command would never provide the requisite training. It should be continuous throughout the command of the Commander-in-Chief.

When the fleet was divided several fallacious arguments were offered in support of the move; but the claim that competition is stimulated by having two separate fleets five or six thousand miles apart by sea is ridiculous. The two fleets are so separated, mail communication so slow, weather conditions so different in the two oceans, that real competition does not exist. Keenest competition is secured when a large force of vessels is assembled, all in sight and in touch with one another. Greater effort is necessary to win the pennant for engine efficiency, gunnery, or what-not in a fleet of one hundred ships than in one of fifty.

The strongest argument of all, the one which Admiral Mahan had in mind when he called the policy of division "suicidal" is that a divided fleet gives an enemy an opportunity to destroy the two fleets in detail. A Japanese fleet, by interposing, might catch one-half of the fleet at a disadvantage; similarly a European nation, by placing a fleet in the West Indies, might accomplish the same end.

The teaching of history, the warning of our greatest naval strategist and the present crying need for economy, unite in demanding that our fleet, no matter where it may be based, shall be reunited into one powerful unit.

Consider the score of economy. Many of our naval ships still burn coal, and there is no coal on the Pacific—it has to be taken there at a huge expense by colliers. Even as regards oil fuel, it should be remembered that while the cost is about the same on each coast, there is a greater supply on the Atlantic with more tanks and better facilities for handling it—hence, fewer tank vessels will be needed and much money saved. The argument on the score of general supplies is even stronger, for nearly all supplies are manufactured on the Atlantic side.

Labor, the greatest element of cost today, is very limited in the Pacific and is more expensive. The same thing is true of steel, all of which comes from the East. Of the greatest importance, too, is the question of personnel, most of which lives on this side of the continent. We have here a more fertile area for recruiting and the nation is put to very great expense in transporting the personnel to and from the Pacific when enlistments and changes have to be made. Finally, in the important question of morale, we must remember that sailormen are as human, perhaps a little more so than the rest of us. They all like to get home occasionally, and as the homes of the majority of the men are on the Atlantic side, it follows that if half the fleet is based upon the other coast there will be a falling off of enlistments and an inevitable discontent engendered.

## Naval and Military

**The Capsize of Eagle Boat No. 25.**—The Eagle boats have never been popular either inside or outside of the Navy. We confess that to our eye they have always looked unstable, and this defect was emphasized during a severe thunder storm on June 11th, when Eagle Boat No. 25 capsized with a loss of nine of the crew. A heavy wind struck the boat during a severe electrical storm; but although she turned turtle, other craft in her vicinity came through the test in safety. The boat was two hundred feet in length, twenty-five feet six inches in beam, and had a displacement of about six hundred tons.

**Our Future Army Strength.**—The official figures for the strength of the Army of the Reorganization Act of 1920 show an authorized strength of 298,882 commanding officers, warrant officers and enlisted men, of which the Infantry will have 38.2 per cent; the Field Artillery, 13 per cent; the Coast Artillery, 10.5 per cent; the Cavalry, 7 per cent; the Air Service, 5.9 per cent; the Corps of Engineers, 4.2 per cent; and the Signal Corps, 1.8 per cent. The annual appropriations for 1914 for the Army was $94,266,145, which is slightly less than one-quarter of the Army appropriations for the fiscal year 1921.

**Expenditure of Ammunition in Flanders.**—The final report of Sir Douglas Haig includes some amazing figures of ammunition expenditure in Flanders. In the opening attack, in 1917, the total expenditure on July 31st exceeded 23,000 tons; and on the two days, September 20 and 21, 42,000 tons were expended. From the commencement of the British offensive in 1918 to the conclusion of the Armistice 700,000 tons of artillery ammunition were expended by the British Army on the Western front, while in the three days of crucial battle on the 27th, 28th and 29th of September, nearly 65,000 tons of ammunition were fired by their artillery.

**The Latest Rigid Airship.**—In the latest rigid airship, R-80, as developed by the Vickers people, particular attention was given to the elimination of unnecessary head resistance and the cutting down of weight, and the builders have produced in R-80 a ship of only 1,250,000 cubic feet capacity, whose performance in speed and endurance is equal to that of R-33 and R-34, which have a capacity of 2,000,000 cubic feet. The over-all length of R-80 is 530, its diameter is 70 feet, and its height, 85 feet. The total gross lift is 38.5 tons at sea level, and the disposable lift is 17.5 tons. At full power, the estimated speed is over 60 miles per hour, and the cruising radius at this speed is 4,000 miles, and 6,500 miles at fifty miles per hour.

**The Object of Lofty Flying.**—The Air Service has issued a statement explaining the object of Major Schroeder's recent flights at altitudes in which he made a world record. It says that there was long and careful planning and much experimental work was done before the flights were attempted. Future wars will be fought largely in the air, and, because of the development of anti-aircraft guns, much of the airplane work will be done at altitudes of 20,000 feet and over. For flight at these altitudes, the aviator must be provided with devices which will enable both him and his machine to function properly, and it is these facts which have caused the Air Service Division of the military service to carry on this highly scientific and very successful work.

**The Seventy-Five Mile Gun.**—We stated, in our issue of April 27, 1918, that the Germans were probably using one of their 15-inch naval guns with a subcaliber tube inserted to obtain the necessary length for the great range of seventy-five miles. It now appears that they did use several worn-out, 45-caliber, 15-inch naval guns. They screwed on to the muzzle of this great gun an additional outer tube forty-five feet in length, and then inserted a tube one hundred feet in length, which was bored and rifled to a bore of 8.2 inches. To the gun as thus assembled they added a smooth-bored twenty-foot section, the total length being 120 feet. This great length was adopted in order to keep down the powder pressure and the erosion. The guns, because of the inequalities in the powder were erratic, and it is believed that after fifty rounds they became so worn out as to be unusable.

## Science

**Making Streets Safe for School Children.**—A commendable campaign among school children is being conducted by the Safety Bureau of the Philadelphia Rapid Transit Company. More than 185,000 school children in that city have listened to stories and talks on "Safety First," and three-quarters of a million pieces of illustrated printed matter on the same subject have been distributed in the schools. A striking feature of this campaign is an organization of 300 boys who daily patrol crossings in the dangerously located school neighborhoods.

**A Naturalist in an Airplane.**—Dr. Chalmers Mitchell, who took part in the recent attempt to fly from Cairo to the Cape, has sent to the *Times* (London) a detailed account of his observations, which serves to illustrate how much valuable work in physical geography and kindred subjects may be carried out by a suitably qualified airman. His bird's-eye view of the Nile basin is a notable contribution to our knowledge of the physiography of that region and of the geological processes which have occurred there. He also furnishes interesting information concerning the larger animals observed along his route.

**More Light on Botulinus Poisoning.**—According to the U. S. Bureau of Chemistry the recent sensational cases of poisoning from ripe olives have occurred almost exclusively in connection with olives put up in glass. A plausible explanation is offered by the Bureau. It appears that the trouble is due to defects in the methods of pickling, packing and processing the olives. In most establishments the product when packed in glass is sterilized at about the temperature of boiling water, and this temperature is too low to ensure the destruction in every instance of the *Bacillus botulinus* and the toxin it produces. The trouble, the Bureau says, is not inherent in the glass container, if sound olives be used and the packages are properly sealed and sterilized. Unfortunately some of the packers in their anxiety not to break the glass containers do not always process the olives at a sufficiently high temperature. The poison would develop just the same in tin under the same circumstances, but as there is no danger of breakage in tin there is usually no hesitation on the part of the packer to apply sufficient heat. The Bureau is urging producers and dealers to make a thorough inspection of all ripe olives in glass and to destroy any that show the slightest sign of decomposition. It is also recommended that all olives, whether in tin or glass, which may have been processed at too low a temperature be sent back to the packers for reprocessing.

**International Meteorological Conference.**—The report of the International Meteorological Conference which met in Paris last October, at the invitation of the French Government, has just been published. In view of the far-reaching changes that have recently taken place in the scope and methods of meteorological work—due especially to the new requirements of commercial aeronautics—this meeting was timely, and most of the national weather services of the world were represented by delegates. The General Powers were not invited to participate; and the United States of America, which possesses the most imposing meteorological bureau in the world, was not represented, because Congress failed to make the modest appropriation recommended by the President to provide for the expenses of two delegates. The conference decided to perpetuate, with some slight modifications, the international organization of meteorology that existed before the war. Sir Napier Shaw remains president of the International Committee. Much important work was accomplished by the conference, looking to a material enlargement in the scope of weather reports and their dissemination, especially by wireless, for the benefit of aeronauts. In lieu of the old commission which bore the misleading name of International Commission on Scientific Aeronautics there were organized two new commissions; one on the applications of meteorology to aerial navigation, and one on the exploration of the upper atmosphere. There are also international commissions on agricultural meteorology, weather telegraphy, marine meteorology, solar radiation, the *Réseau mondial*, terrestrial magnetism and atmospheric electricity, and polar investigations.

## Automobile

**Keep Clips Tight.**—Spring clips should be inspected at least once a week and tightened as much as possible. If the clips become loose, the spring will break between the clips. If there is undue stretching of the clips, the difficulty might be overcome by having new clips made of better material, as it is always cheaper to replace clips which are too light than to have broken springs as a result. The bearing place upon which the spring rests on the axle should absolutely conform to the curvature of the spring at that point, as sufficient bearing surface is just as important as tight spring clips.

**Why Horses Are Retained on Farms.**—When discussing the motorization of the farm, agriculturists are always ready to state that even though most of the work of the farm will be done in the future by motor devices, the horses will still be found necessary. Attention has been called to the fact that street car railroads were electrified and for a long time maintained large stables of horses. Electric roads have no horses today. Big business in the large cities motorized and for long periods continued to maintain stables of horses because of some lack of confidence in the motor equipment to meet an emergency that never came. Big business interests are now gradually giving up their horses. Farmers will motorize and continue to keep their horses until such time as their confidence is thoroughly established in the motor equipment of the farm motor truck, tractor, etc., when they will quickly give up the horses.

**Automotive Industry Magnitude.**—That 1920 will be the greatest producing year thus far in the history of the automotive industry can be readily foreseen, with the great demand for motor vehicles in this and other countries. Production in America has reached such a point that the National Automobile Chamber of Commerce announces that this year's business will rank second only to steel. The 1919 production totaled $1,807,594,580 and if bodies and accessories were included, this figure would exceed $2,000,000,000. Exports of automobiles and parts, including tires and engines, for the government's fiscal year ending June 30, 1919, surpassed all previous records by aggregating $185,000,000. The former high record was in 1916, when $140,000,000 business was done with foreign nations. Of the total amount of 1919 exports, $35,000,000 worth was commercial cars, $75,000,000 worth was passenger cars, $41,000,000 parts of automobiles and nearly $30,000,000 worth was tires, while about $5,000,000 worth was automobile engines.

**Taking Down the Motor.**—In order to look over the parts of an engine and to restore the worn or defective components it is necessary to take the engine entirely apart as it is only when the power plant is thoroughly dismantled that the parts can be inspected or measured to determine defects or wear. If one is not familiar with the engine to be inspected, even though the work is done by a repairman of experience, it will be found of value to take certain precautions when dismantling the engine in order to insure that all parts will be replaced in the same position they occupied before removal. There are a number of ways of identifying the parts, one of the simplest and surest being to mark them with steel numbers or letters or with a series of center punch marks in order to retain the proper relation when reassembling. This is of special importance in connection with dismantling multiple cylinder engines as it is vital that pistons, piston rings, connecting rods, valves, and other cylinder parts be always replaced in the same cylinder from which they were removed, because it is uncommon to find equal depreciation in all cylinders. Some repairmen use small shipping tags to identify the pieces. This can be criticised because the tags may become detached and lost and the identity of the piece mistaken. All parts should be thoroughly cleaned with gasoline or in the potash kettle as removed, and wiped clean and dry. This is necessary to show wear which will be evidenced by easily identified indications in cases where the machine has been used for a time, but in others, the deterioration can only be detected by delicate measuring instruments.

# A Chemical Loafer, and How It Was Put to Work

## Argon, the Laziest of All the Elements, Plays a Big Rôle in the Latest Incandescent Lamps

By E. W. Davidson

ONE of the most useless of the constituent elements of the air we breathe was turned to a highly valuable use for mankind when argon gas was first injected into incandescent lamp bulbs. By filling lamps with this gas which is among the laziest of all gases, and by observing certain precautions, the efficiency of the lamp thus made was greatly increased. Furthermore, argon gas has helped the larger sizes of incandescents up to the huge 1,500 watt lamp to displace arc lamps for street lighting purposes.

Sir William Ramsey first discovered argon in 1894 which he found to constitute about one per cent of the atmosphere. By this discovery he filled out one of the blanks in the chemical periodic system. Previously it had been noted that nitrogen extracted from the atmosphere was heavier than nitrogen produced by chemical process. The search for an explanation of this led to the discovery of argon. But he found absolutely no practical use for the new gas. For 25 years this valuable element was permitted to continue in its happy state of desuetude.

Nobody used argon until Dr. Irving Langmuir in the Research Laboratory of the General Electric Company at Schenectady discovered the increased efficiency to be gained in incandescent lamps by filling them with inert gas instead of merely making them vacuous. He used both nitrogen and argon.

Nitrogen was promptly put to use in lamps because it is comparatively easy to extract so prevalent an element from air, but nobody used any argon on a large scale until about 1914 when an air products company constructed machinery, which by fractional distillation from liquid air, produced it in considerable quantities mixed in equal parts with oxygen and nitrogen. This is the form in which it is marketed today. At lamp factories the oxygen is thoroughly removed by passing the mixed gases through a tubular furnace nearly filled with copper filings at red heat and about 90 per cent of the nitrogen is extracted in another furnace. Then the argon, about 90 per cent pure, is injected into lamp bulbs.

The very inertness which once stamped argon as absolutely useless has proved to be its valuable quality. The facts that it is relatively stubborn in its refusal to serve as a conductor of heat and that its density discourages the evaporation of tungsten filaments even at tremendous heat have therefore made it possible to increase the temperature of lamp filaments with a consequent increase in lamp efficiency beyond the point which was the previous maximum. So a greater candlepower is possible without undue deterioration of the filament; or keeping candlepower fixed, the life of the bulb is prolonged.

The air is exhausted from the lamps when the turn-table carries them through the oven. They come out at the left, are cooled by air-blast, and as they come to the position beneath the operator's left hand the argon is injected from below.

**Filling lamp bulbs with the purified argon**

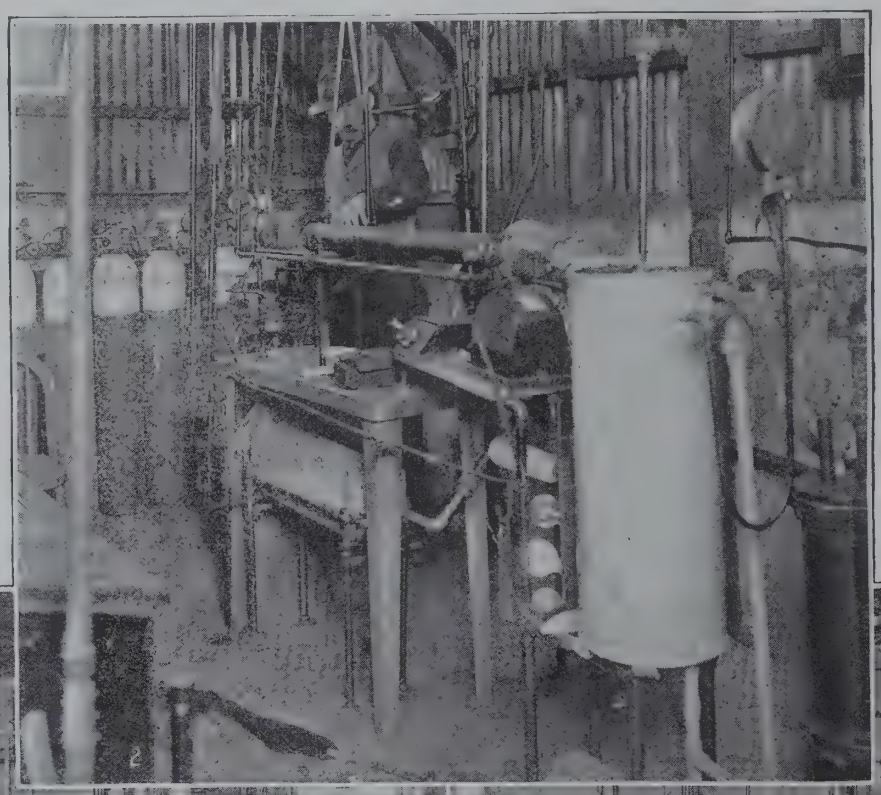
Although it has not been economically advantageous to use argon in the lowest current lamps, its use renders the higher current lamps more brilliant and efficient. Large argon-filled lamps equal in efficiency the magnetite arc, so as to serve for any sort of street lighting except to produce the brilliant glare needed for "white ways." Argon-filled incandescents, which can be mounted in varying sizes on a single circuit to meet varying needs as arcs cannot be, and whose glow never flickers as does the glare of arcs, have established their supremacy for general outdoor lighting as well as for other medium and high-power illumination needs.

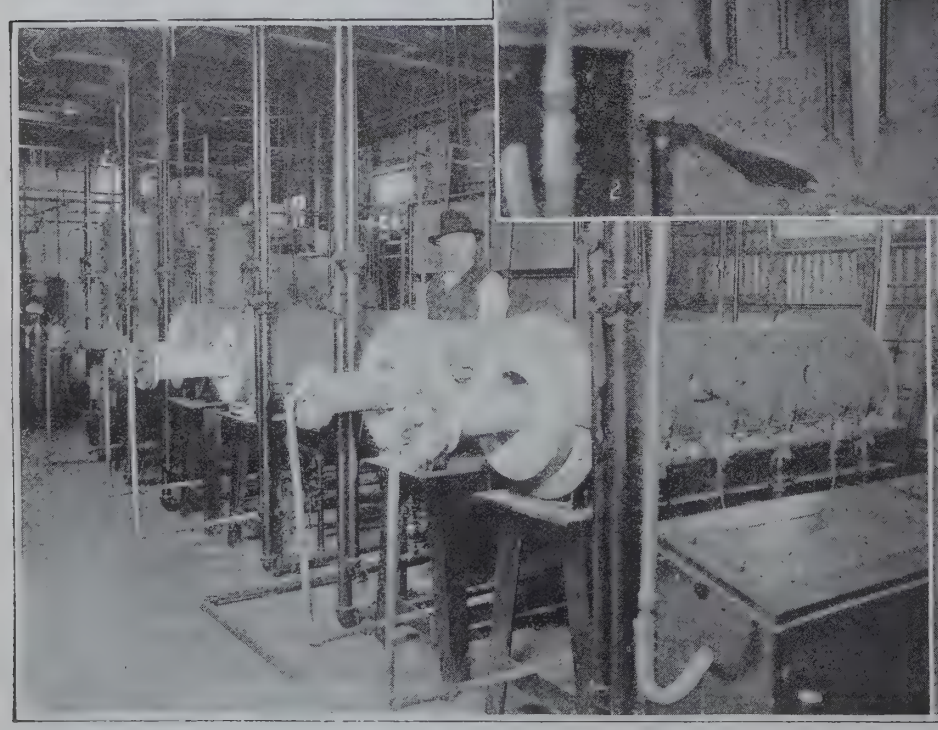
### Rail and Street Car Indicator

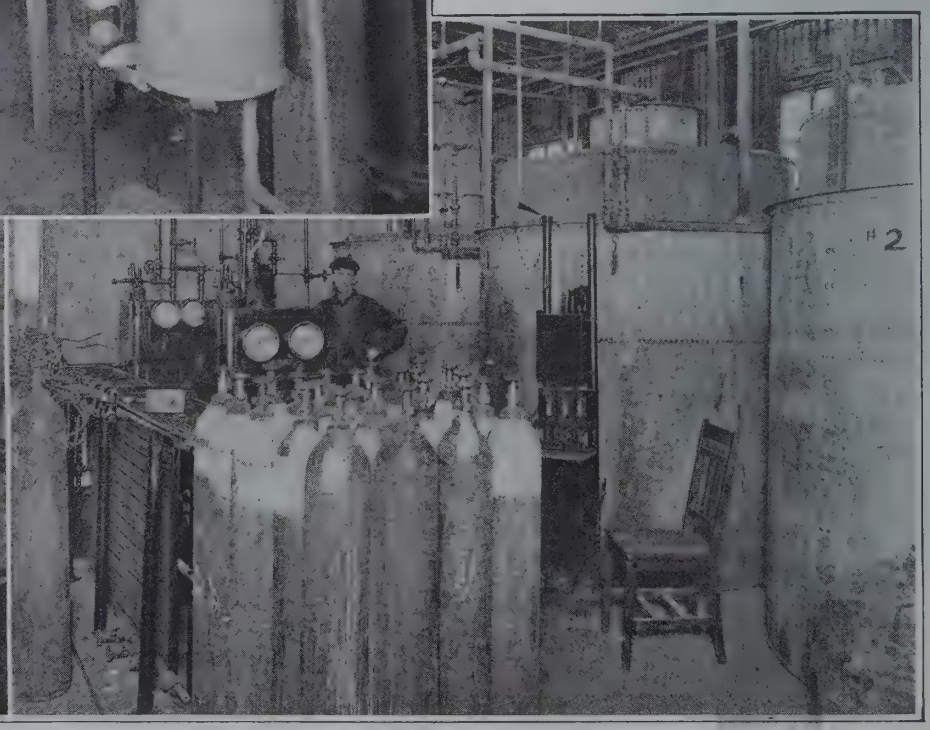
THE London Metropolitan Railroad has arranged to put into operation on its system an electrical device whereby the names of stations are indicated in the passenger cars. The system is operated by illuminating sections of the ceilings of each compartment, arranged in panels, each of which in turn becomes prominently lighted up as the journey proceeds. At the commencement of the journey the next station becomes so indicated; when that point has been left, the section or panel applying to it becomes dull, but the next becomes illuminated. Before starting a journey the motorman actuates a series of switches, and the rest of the action is automatic, the mechanism being operated by a small striker on the track between the stations. In addition to the names of the stations, it is intended to show a map of a square mile of streets around each spot, giving shopping centers and amusement places.

This indicator is to be put into operation on the Great Northern tube.

The concern controling the device claims that as passengers will thus easily become acquainted with their whereabouts, time should be saved and congestion relieved.

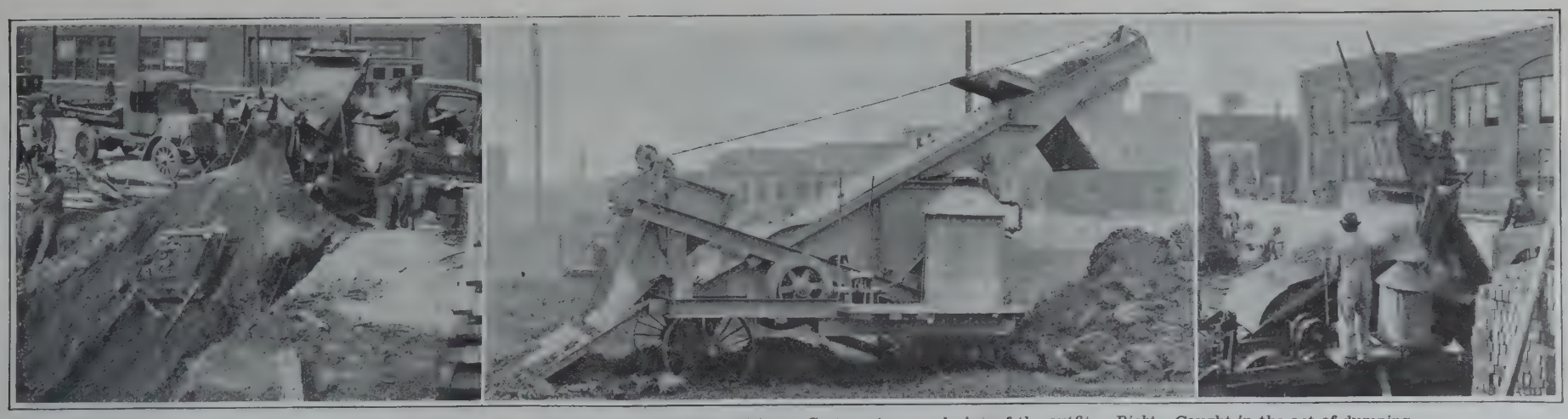






1. The calcium carbide furnaces in which the argon is purified of nitrogen at a temperature of 900° Centigrade, and brought up to 80 per cent pure. 2. The first step; the commercial argon received in the cylinders is burned in a hydrogen flame to free it of 30 per cent of oxygen, after which it goes to the furnaces shown in the first photograph. 3. The finally purified argon is pumped through big meters and into the cylinders, from which it is fed into the lamps.

**Removing oxygen and nitrogen from commercial argon to make it fit for use in filling incandescent lamp bulbs**



*Left :* Hauling the drag full of excavated material up to the dumping position. *Center :* A general view of the outfit. *Right :* Caught in the act of dumping

**The drag-line excavator-loader that delivers the material to the truck in the very bucket that digs it**

## Digging and Loading in One Motion

**By B. F. Mundorff**

A NEW excavator-loader is especially designed for excavating work, for the removal of materials from one location to another and for general work where flexibility of operation is not limited so closely as in the case of the steam shovel. It likewise eliminates the pickax and shovel worker entirely.

The machine is in reality a portable dragline, filling the gap between the steam shovel and the antiquated and expensive gang of hand shovelers. Because of the principle on which it operates, portability is a feature "built in" this excavator and loader. Only two men are necessary to the operation of the machine; one at the operating levers and one at the loading point. To a point anywhere within 50 to 200 feet from the machine is stretched a chain, at right angles to the line of digging; upon this chain are two sheaves hooked to the chain. Either sheave may be unhooked and relocated in an instant. One heavy cable passes from the hoist drum on the machine, then to the digging skip, then through both sheaves, back to the retrieving hoist drum on the machine.

The operator of the machine manipulates but two levers and a foot brake. As he places power on the digging line the other man manipulates the handles on the skip, so as to fill it with the material to be dug or removed. The skip has a capacity of 15 cubic feet per trip. As soon as the skip is filled the man releases the handles and allows the skip to ride to the excavator. As the skip strikes the apron at the machine it unlocks the catch arm then carries the skip up over the machine and on to a slanting chute located on the front of the machine from where the material in the skip discharges into the waiting wagon, truck or railroad car. The skip is then quickly retrieved to the starting point and the operation repeated.

**Shoveling the coal on the barge for delivery ashore**

## Pedigreed Chicks from Incubators

WHEN eggs are hatched in incubators, the difficulties incidental to pedigree work are such that many poultrykeepers do not attempt it, simply using eggs from selected hens and letting it go at that. Others hatch special pedigree eggs under hens. Mosquito netting bags for incubators, into which the marked eggs are placed on the 18th day of incubation, each sack being indexed, are successful, but somehow do not "catch on" with poultry breeders. The new cornpopper plan will be much more popular with the average breeder. It is so simple that any poultrykeeper can use it.

Two-quart wire cornpopper baskets, the common kind purchasable at any hardware or general store, are used, one basket for the eggs of a particular hen. Attached to the basket is a tag on which the hen's number is entered. During the hatching time, in this manner, the chicks of one hen, or the chicks of several, may be kept separate. Whether the pedigree work is simple or elaborate, the cornpopper plan is efficient. The breeder must bear in mind that when cornpopper wire baskets are used chicks have less room to hatch in than when the whole floor of the incubator is free to them. If the hatching percentage is heavy, and many of the eggs are pedigreed, there can easily be overcrowding. For this reason the poultry keeper should watch the operation, and if an emergency arises be prepared to transfer some of the eggs for hatching to a second incubator, so that there will be room for all. The object can be attained by loading incubators under capacity.—By *J. T. Bartlett.*

**The screen that separates the coal from water and non-combustible solids**

## Mining Coal with a Dredge

**By George Gaulois**

IN many parts of the anthracite and bituminous fields of the East there are to be found locations where the mad rush of previous generations to skim the cream from Nature's offerings, regardless of what happened to the skimmilk, has resulted in leaving in the river bottoms large accumulations of coal which the miners of a generation ago felt that they could not afford to transport to market in the presence of better grades and more convenient sizes. Today, in the search for economies, we are beginning to bring this coal to the surface and avail ourselves of it. In addition, there are a few places where there appear to be deposits of coal in their original positions at the bottoms of water courses, and these frequently can be mined by the same methods utilized to get at the submarine dump-heaps of former days.

Sometimes the work is done from shore, sometimes from barges moored out in the stream. We illustrate herewith a process of dredging, followed by screening of the material brought up from the river bottom, which is resulting in the recovery of a lot of good coal from the Susquehanna River, near Danville, Pa. The coal here is of fair size and good quality, and comes from the water in the shape of smooth rounded lumps. There is of course a good deal of non-combustible solid matter with the coal, but this can be said of mine coal, and its removal from damp, dustless river coal is if anything more easily effected than in the case of coal brought up from below ground. One of our illustrations shows the apparatus with the aid of which this is accomplished and the coal separated from the water at the same time, while the other gives ocular evidence that this scheme for coal recovery is on a very respectable scale.

## A New Form of Vibration Galvanometer

VIBRATION galvanometers are very useful in zero measurements, but have not been much used in industrial laboratories on account of their being sensitive to external vibrations and requiring delicate adjustments. A new instrument developed by the United States Bureau of Standards, which has a sensitivity higher than other forms of the moving-iron type, but less than that of the most sensitive forms of the moving-coil type, has the advantages of sturdiness, quick responsiveness, and freedom from the effects of external vibration. It consists essentially of a fine steel wire mounted on one pole of a permanent magnet, and so arranged that the free end of the wire may vibrate between the poles of an electromagnet through which the current to be detected passes. The paper describing this instrument, Scientific Paper No. 370 of the Bureau of Standards, is now ready for distribution and any one interested may obtain a copy by addressing a request to the Bureau.

# Turning the Wheels of a Century Hence—III

## What the United States Must Do to Forestall the Day When Fuel Goes Beyond the Common Reach

By C. H. Claudy

THE first reason, of course, why we have not developed every bit of our available water power, is the economic factor that all water power is not sufficiently near a market to make its development commercially possible. That is a condition which time will remedy as the demand becomes more acute; a market will be created by industries willing to move to or near the power site. Second is the fact that water is an asset of the nation, not of individuals, and that in a laudable endeavor to conserve the nation's asset for the nation, the nation's legislators have often gone too far and put such heavy restrictions upon the construction of water powers as to scare away capital and make it afraid to invest. Such a restriction is found in the requirement that a Federal license be revokable by the power of one man. No one man, no matter how wise, has vision enough adequately to consider all points in so complicated a question as this, and capital rightly believes that it should not risk its life against the decision of a single individual.

Third in the limiting factors is the conflict of interests between the power makers, the power users and the users of water as a means of transportation. No navigable river should be closed to navigation by the construction of a power dam. So much is self-evident. But navigation interests go farther than that, and frequently object strenuously to a power dam, even if provided with adequate locks by which navigation can be kept open. Also the question as to what constitutes a navigable stream is one not to be decided offhand. Some streams float logs which float nothing else, yet logs are important to industry. Canoes and ocean liners alike bear freight, yet who is to be wise enough to state at what point the draught of a vessel decides the navagability of a stream?

The Sherman Act may act as a limitation upon power developments, for a very odd reason. To make this plain it will be necessary to say a word of the practice of "coupling" power stations, which may perhaps best be done by quoting from a government report on the subject. It is stated that it may occur, that of two power sites tributary to a given market, neither will meet the demand, whereas if both are used together they will. If, for example, there is a market for 5,000-horse-power and there are two accessible power sites, one capable of supplying 4,000 continuous horse-power and the other 1,000 horse-power, it is obvious that neither alone can meet this demand; but if the two should be "coupled" together the demand can be met. This may be called making the smaller site auxiliary to the larger. It is true that the power from both sites can reach the market and can, therefore, supply it even though they are not coupled. There would, however, be the expense of separate transmission and distributing equipment and separate management, and this expense might be such as to prevent the development of the smaller power.

### One Plus One Not Always Two

Again assume two sites, one capable of meeting the demand during the hours of minimum requirements and the other large enough to meet the maximum demand extending over, say, 10 hours. If the larger plant is kept in operation constantly, its pondage will be so reduced that within 24 hours or, at the longest, in a few days, it will not have sufficient power to meet all the demand. The smaller site can at no time meet the maximum demand. In this case neither site can separately supply the market all the time, but coupled together they can. Thus, if one site alone is able to meet the lowest demand and during this time the other plant can remain idle and accumulate water, this accumulation will contribute to meet the larger demand during the busiest period of each succeeding day. The principle is equally applicable whether the sites are on the same or on different streams, provided such sites are accessible to a common market.

It may not at first sight be plain why there is so great a saving as engineers tell us is actually made, when the coupling together not of two but of many plants is accomplished. But remembering that an isolated plant must be capable of supplying its maximum demand, which capacity is not used to the limit for more than two-thirds of the time, consider the testimony of Mr. C. C. Merrill of the Forest Service before the Committee on Water Power of the House of Representatives last year. Said Mr. Merrill: "The larger the power market served, the greater is the diversity of use, the more regular and continuous the demand, the higher the load factor, and the smaller the percentage of surplus equipment required. Eighty per cent of the electric power development of the State of Montana is in one single power system. The capacity-load factor for that state in 1912 was 58 per cent as compared with 26 per cent for the United States as a whole. Studies made in 1912 for the cities of New York and Chicago showed that the consolidation of the operating stations in the latter city would have saved from $10,000,000 to $12,000,000 in investment. Similar consolidation in the city of New York would have saved from $18,000,000 to $20,000,000 and would have reduced operating expenses by $1,000,000 a year.

### A Big Game for Big Players

"Had our railroad systems consisted of short, independent, competitive lines, each interested in serving its particular local territory, they would have been utterly helpless in the face of the transportation situation of the war-time period. Even as they were, further unification became necessary in order to meet the extraordinary traffic demands. Power development, particularly in the great manufacturing states of the East, where the greatest demand exists, is still in large degree in the primitive state of isolated independent development. Were these stations interconnected to the full extent which is now thoroughly practicable, hundreds of millions of additional kilowatt-hours of electric energy could be made available without the addition of a single dollar's worth of new equipment.

"While interconnection of stations is a measure of economy in steam-power development, it is a measure of necessity in any general water-power development, particularly in the eastern United States. No considerable development of eastern water power will come about except through interconnection of plants over wide territories in order that the diversity of demand in different markets and the variation in water supply at different sites may raise the load factor of the combined system to a point where steam-power competition can be met.

"On account of the extent of the territory which will be involved and of the fact that the power transmission systems must ignore State lines no authority less than that of the Federal Government will have sufficient jurisdiction either to conduct the investigations or to exercise control over the completed system. There is a transmission system already operating in California, the termini of which are as far apart as Washington is from Eastport, Me., or from Jacksonville, Fla. The future of water-power development in the East must be along similar lines."

Here is where anti-trust legislation is a handicap. Our nation after rioting in competition, passed to a great centralization of industry, only to become frightened at the power of even "good" corporations. Came the Sherman Act, and as we all know, the Standard Oil "trust" was "dissolved" and the packers are being made legally to behave and the steel industry escaped dissolution by the skin of its teeth and so on. Capital is afraid of an industry where combination is salvation, and independence, suicide. We must have vast power systems, linked together physically, in order that the fluctuations of demand on the one side and water flow on the other can be met. It is not feasible to interconnect dozens, perhaps hundreds, of power sites physically and not have that connection extend to some degree in the business relations. Legislators have done wisely, perhaps, to limit combinations of factories and businesses to the thwarting of competition. But that same limitation applied to water power may strangle not only the combination but the power.

### Where Congress Comes In

There have been very few developments of water powers in the last few years, largely because the country has been waiting upon Congress to pass a new water-power act which would clarify the situation and remove the difficulties from the path of development. A bill has been passed in House and Senate and is now in conference, from which it will emerge some time, possibly at this session, in what form no man knoweth. The bill is a weighty document, and considers so many features of water-power development that it cannot even be summarized here, but it does license water-power development for a period not exceeding fifty years and does provide that such license once granted cannot be revoked by any one man's authority.

The provision for control through the possibility or loss of license is simple and direct. It says: "That the Attorney General may, on request of the commission or the Secretary of War, institute proceedings in equity in the district court of the United States in the district in which any project or part thereof is situated for the purpose of revoking for violation of its terms any permit or license issued hereunder, or for the purpose of remedying or correcting by injunction, mandamus, or other process any act of commission or omission in violation of the provisions of this Act or of any lawful regulation or order promulgated hereunder. The district courts shall have jurisdiction over all the above-mentioned proceedings and shall have power to issue and execute all necessary processes and to make and enforce all writs, orders and decrees to compel compliance with the lawful orders and regulations of the commission and the Secretary of War, and to compel the performance of any condition imposed under the provisions of this Act."

The general public, of course, has little knowledge and less interest in questions of this kind, merely because they have not reached an acute stage. But power is to be the future warmth of this nation, and there are some resources which will never be developed without power, cheap power and plenty of it. We know how to make our own nitrates, yet Chili continues to be our nitrate bank. The air is free to all—the nitrogen we need for fertilizer and for munitions is four-fifths of it. It can be extracted and made useful. Give us enough cheap power and Chili can exhaust her nitrate beds for all we care.

### Power and Transportation

Transportation is the life blood of a nation. Our history has been a history of railroad development, now being paralleled by the construction of good roads and the infinite multiplication of self-moving units—trucks and automobiles. But the days of gasoline, at least at present or lower prices, are numbered. Some substitute must be found. Synthetic fuel can be made but the manufacture takes power. Shall we burn coal or oil to make another fuel to burn? Or shall we utilize gravity to drive our motor trucks *via* electric power made at the falls and converted in one way or another to the synthetic fuel which represents for us our only practical way of storing power?

If the United States is to continue in the future what it is now, as the leading manufacturing nation, and if it is to make full use of the greatest number and diversity of natural resources which an all-wise Providence ever provided for any country, it must use power in large quantities. That power nature has given us. The rivers are here. There are vast numbers of natural falls. Artificial falls but await the magic touch of the imagination and the engineer to come into being. Reclamation projects with their huge dams already use the water first for power, next for irrigation. Are we to neglect this, our greatest natural resource, because of economic specters, legislative ghosts, intangibilities like state lines, statutes like the Sherman law, enacted with no such idea in mind?

Here are we, owners in fee simple of millions of

(*Continued on page 72*)

*WHEN we have followed Mr. Claudy while he makes it plain that in the development of water power lies the only direction in which we may hope for relief from the prehistoric necessity of burning fuel when we seek heat or power; and when we have pursued his discussion of what constitutes water power and what does not—why, then, the natural question is, "Why have we not developed every bit of our available water power?" The answer to this question and to its natural companion, "What are we going to do about it?" form the theme of the present and last article in the series.*—THE EDITOR.

# Fighting Waves with Compressed Air

## An Artificial Reef of Air That Breaks Up the Rollers and Makes Them Harmless

By George F. Paul

THE use of compressed air to prevent piers from being demolished and shores destroyed by the merciless pounding of the breakers is a modern method that is proving successful in actual service. It took men a long time to figure out this simple yet effective means of making the mightiest waves as harmless as the ripples kicked up by a good stout fish. The compressed air fights its way to the surface of the water with a combined rising and explosive action. This breaks up the wave motion. The wave is simply confused—it cannot go ahead. It hesitates, curls over, breaks on the rising wall of air and water and then subsides with all its immense energy spent. Back of that point the water is protected, so that the shore is safe and vessels can ride undisturbed at anchor.

That the sea waves have the power to do tremendous damage is shown by repeated tests along various coasts, special instruments being used. The British Isles are among the greatest sufferers from the incessant pounding of the waves. Tests made along the North Sea coast showed a striking force of from three to four tons to the square foot. During a storm at Wick, huge blocks of concrete averaging 1,350 tons and 2,500 tons respectively were displaced.

Builders of sea-walls along the coasts of the United States have found that they had a powerful foe to deal with, and one that all too often got the better of the expensive defenses that they constructed. For instance, the actual value of property destroyed in the single town of Seabright, New Jersey, was enormous, and the sufferings inflicted on its citizens cannot be estimated. It would be hard to estimate the depreciation in property values along that part of the coast line, a depreciation shared by the lands not actually eroded, because of the apparent magnitude of the danger to which they are subjected.

It is because of these conditions that work has been undertaken to perfect compressed air apparatus that would successfully fight off these repeated encroachments of the sea. These experiments have proved very costly because of the large scale on which the work had to be done.

Now it has of course been long known that waves would break on a reef when they are of any magnitude and are in water of considerable depth. This is due to the interference with the continuity of the lower section of the wave action because of this sudden inequality in the floor of the ocean. Taking advantage of this fact, builders in Holland and England have constructed artificial reefs or wave breakers of random stone, with the idea of causing the wave to break on this and thus exhaust its force. Although this plan is efficient on some coasts, yet there are several objections to it. One of these objections lies in the fact that the stone reef interferes only with the lower layer of wave-action.

Theoretically it is a very simple thing to talk of the formation of an artificial reef at any point by using compressed air expelled from a perforated pipe lying on the bottom to form such a reef. There were, however, a number of practical considerations that had to be tested and worked out before such an idea could become commercially valuable. Some of the questions that came up immediately were these:

What would be the necessary amount of air required per foot of perforated pipe used to produce calm water?

How could this air be equally distributed?

How could this perforated pipe be prevented from filling with sand?

Obviously, the only way to answer such questions as these was to install such plants and watch the operation. The first tests were made on a muddy bottom in New York harbor at a depth of 30 to 40 feet to determine the most efficient size for the perforations in the pipe and their distance apart. A second trial was made at the end of one of the costly piers at Atlantic City, on a sandy bottom at a depth of 21 feet. The next test was made on "the stern and rock-bound coast" of New England, off Crotch Island, Maine. On the day of the trial, waves were rolling so high that the spray was flying over the tops of the trees along the shore. Fifteen minutes after the air was turned on, it was possible to paddle around in a canoe in the smooth water that the air breakwater furnished.

The U. S. S. "Yankee" managed to get ashore on Hen and Chicken reef in a very exposed position off the Massachusetts coast. Before the air was turned on, the seas were boarding the ship fore and aft, causing it to grind very much on the rocky bed and making it very difficult for the wrecking crew to do any work. After the air was turned on in the breakwater, it was as if the ship lay in a lagoon formed by the air breakwater.

The latest plant to be established was one in front of an expensive pier at El Segundo, California. This pier, which was originally 4,000 feet long, and has cost hundreds of thousands of dollars to build and maintain, had nearly 2,000 feet washed away in recent severe winter storms. To save the remainder of the pier it was decided to try the compressed air method. The plant consisted of three sections of perforated pipe, the first section of 120 feet being out in front of and at a distance of 145 feet from the pier head. The two other sections were 100 feet each and lay at right angles to the pier, one on each side, starting right from the pier head. Not only have these pipes kept the pier from being swept away, but they have also broken up the ground swell which so often interferes with the loading of vessels at piers along the Pacific coast. The swing of the boats alongside the piers has often been so strong that 14-inch manila lines have been known to be snapped like pack threads.

The Pacific coast is especially in need of some means for treating artificial harbors. There is not so much coastwise shipping as there undoubtedly would be if

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# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### The High Cost of Milk

To the Editor of the SCIENTIFIC AMERICAN:

This household has been a subscriber of yours directly or indirectly through a local news agency for the past forty years. We have always found it a source of satisfaction to know that we possessed dependable information about our navy, the various great engineering undertakings, our coal or oil resources, besides greatly diversified mechanical information which is becoming so fundamentally necessary to a farmer living in these mechanical times.

I am merely a farmer, laboring long hours on a farm of some 350 acres. I have little time to read, but I keep in touch with the features of each issue as they appear.

In your issue of November 22, last, I was particularly interested in the article on "The High Price of Milk" by Alfred J. Lotka. Mr. Lotka's opinion is correct so far as it goes. The farmer can produce more milk and produce it cheaper by knowing his cows individually and by conducting his dairy operations scientifically as suggested; but if I were to write an article on "The High Price of Milk" I should not omit the most important part—the cost of distribution. Do you know that it costs more to distribute milk in New York City than it does to produce that milk and deliver it to New York? Do you know that farmers are actually penalized during nine or more months of each year for producing too much milk? In most cases the farmer has to part with this surplus milk at a considerable loss.

The farmer has not received the cost of production for milk, which has caused him to diversify his farming as much as possible. But now it appears that the labor situation may force the farmer to work on the basis of an eight-hour day or pay excessively higher wages for a longer day.

Within the past three years in this fertile Mohawk Valley I have seen the families on ten farms in this immediate community comprising 1,400 acres auction off their goods and move to the cities. On some of these farms it is now common to see large fields of 30 or 40 acres stand in weeds. These people had become tired of 12 to 16 hours a day of drudging, Sunday as well as Saturday afternoon, for less pay than they could receive in the cities for eight hours' work without any equipment. The whole trouble lies in your extravagant delivery system in the city. You have hundreds of wagons with their drivers that do nothing but deliver milk to the retail buyer for a few hours each morning. You have huge depots where these wagons load and to which they return and in which nothing but milk is handled. You have a vast organization that does nothing but buy milk from the farmer and deliver milk to the user and manufacture milk products out of the residue that remains undelivered.

How much do you think you would pay for your morning paper if the young fellow who leaves it at your door did nothing but deliver papers over his morning route? if instead of utilizing subway and every other existing facility the jobbers in this field delivered all orders to the retailers in their own trucks, used for nothing else? if instead of the regular news company that deals in weekly and monthly magazines and maintains stands that sell candies, tobacco, etc., etc., you got your morning edition through a news company with an equally ambitious organization, but dealing only in morning papers? Of course milk is a food, and a mighty important one, and of course the problems of producing and marketing it are complex ones. But with the example of the great packers before us, can we maintain that on this account the production and sale of milk ought to be asked to maintain such a large and exclusive establishment? I do not suppose, if you raked the city with a fine-tooth comb, you could find another industry in which the overhead expense and the invested capital bear so high a ratio to the wholesale cost of the product dealt in.

By all means let those who feel that their milk must come to them *via* a personally conducted tour in a private coach under the conduct of a special footman have their milk brought to them that way. But why should all consumers be asked to patronize this system? If it were not a sufficiently vicious one on the grounds I have already covered, it would be branded as intolerable by the domination which a reckless labor organization of drivers has attained over it. Think of it—fifty, sixty dollars a week for a service which in a simpler community did not exist. Why should milk be thus coddled, above all other foods? You buy meats and other perishable items that have to be put on ice, and you don't insist that they come to you ten minutes before you are ready to use them. A rational system of distribution through existing retail stores that dispense other foods—that is the real answer to cheaper milk. And until some such measure is adopted for freeing milk of the excessive overhead which it has to carry, and from the ruthless greed of an organization of the most unskilled labor that I can imagine, there will be little relief for the farmer or for the consumer.

We, as farmers, can live and maintain our health with conditions as they are, but Dr. Copeland, your health commissioner, will tell you that many children in your city will later become tubercular because they have suffered malnutrition due to a lack of milk during their growing years.

I trust you will appreciate the importance of this matter and will lend your good offices toward helping to correct this abominable situation.

Amsterdam, N. Y. D. BOYD DEVENDORF.

### The Airplane Cloud

To the Editor of the SCIENTIFIC AMERICAN:

On page 357 of the April 3rd issue of the SCIENTIFIC AMERICAN appears a paragraph under the heading "Cloud Formation in Wakes of Airplanes."

Although I have never heard the phenomenon described as it is in this paragraph, I have often observed it. Quite naturally, I always supposed it was an attenuated stream of smoke—rather than a cloud—visible only because of exceptionally clear atmosphere.

In July, 1918, I saw this cloud in the wake of an airplane flying about four miles high, over the Front at Albert, France. Then, during the last week in September and the first week in October, 1918, I saw the same thing several times near Verdun, France. In every case the cloud appeared exactly as it is described in the SCIENTIFIC AMERICAN although the lengths I observed were not as long as those mentioned. I estimated the lengths to be about five to ten miles.

Chicago, Ill. R. V. WILLIAMS.

*Left:* Conditions in the Frying Pan watershed, in Colorado's National Forest. Burned area in foreground. *Right:* Debris left after logging of redwoods in California, with dead Douglas spruce killed by the fires set to clear up the redwood slash

**Fair samples of what we are doing to our valuable timber lands**

# What About Our Forests?

## How Long Shall We Be Able to Cut Them Down Four Times as Fast as They Grow?

### By H. A. Mount

*THE situation in which the paper industry finds itself because of a growing shortage of pulp wood is indeed alarming. But this is only one aspect of the far-reaching problem of our dwindling forests. Few of us realize the extent of our dependence upon the forests for prosperity. The census bureau estimates that of 276,000 manufacturing concerns listed, 52,000 of them depend wholly or in part on a continued lumber supply for continued operation. These represent an investment of $3,000,000,000 and employ 1,130,000 men—one-sixth of all the workers in the United States. And the raw material which occupies such a place in our economy we are consuming four times as fast as Nature can replace it.*—THE EDITOR.

WE are using up our forests three times faster than they are growing and experts predict that in less than half a century our supply of saw-log lumber will be gone. White pine in the Lake states is nearing exhaustion and these states are now paying $6,000,000 a year in freight bills to import lumber. New England, self-supporting in lumber twenty years ago, now has to import one-third of the amount used. Half of the fir or balsam in eastern United States, which forms an important part of the timber supply there, is at this moment either dead or dying because of neglect. We provide insufficient protection against fires for our remaining forests and every year $20,000,000 worth of timber is destroyed in this way. The area burned each year is three times as large as the devastated sections of France and not only is the standing timber destroyed, but reproduction upon thousands of acres is killed.

These are just a few of the pertinent facts that are bringing about an awakening to the situation. The American Forestry Association of Washington, D. C., of which Charles Lathrop Pack is president, has actively begun a campaign in the Capitol for legislation providing a national forest policy, under which forests can be adequately protected from fire, conservative cutting can be practised, reforestation accomplished, and devastation stopped. They have been aided in their campaign by the daily press of the country, which has had the situation thrust upon it in a forceful way by an acute shortage of wood for making paper pulp. The newspapers, therefore, have been willing spreaders of needed propaganda.

But the destruction of our forests extends its results even further than the hampering of industry. It affects weather conditions, experts tell us. The increase in numbers of storms and tornadoes in recent years has been blamed, to some extent, at least, on the lack of trees. Forests regulate the flow of streams and the cutting of forests at the headwaters of navigable streams is sure to cause disastrous floods at one season and low water at another.

The Ohio River is a good example. Cutting of the forests in West Virginia has greatly affected the flow of the river. Every spring thousands of dollars worth of property and many lives are destroyed at Pittsburgh and Cincinnati, and at scores of other towns and cities along its banks, while in midsummer the river sometimes is so low that navigation is hampered.

In the face of these facts, it is hard to understand why we have so long neglected our forests. It is due, in a measure no doubt, to the lingering among us of the old Colonial notion that our forests are inexhaustible. But more likely it is due to a characteristic American aversion for spending money on operations where the profits are deferred many years, even for generations. Unlike the French, we acknowledge no indebtedness to posterity.

Our lawmakers have shown this very spirit and when a cry for economy is raised our already meager expenditure for forest protection is cut another notch.

And so we go blithely on, cutting down our timber four times as fast as it is growing and in spite of the fact that the Secretary of Agriculture estimates three-fifths of the country's original timber supply is gone. We are now attacking our last great reserve of timber—the forests of the Northwest.

The migration of the woodsman, from East to West, can be traced in statistics which are available since 1850. Then three-fourths of our lumber came from the Northeast and Central states. In 1918 the same states furnished 15 per cent of our lumber.

In 1850 the Lake states furnished 6 per cent of our lumber. In 1880 thirty-five per cent came from these states, in 1889 twenty-five per cent, and in 1918 ten per cent. In 1850 the South furnished 8 per cent of the lumber used, in 1918, 35 per cent. The Pacific coast gave practically no lumber in 1850, 15 per cent in 1909 and 27 per cent in 1918.

It will be seen that the principal supplies now come from the pine forests of the South and the great wooded mountain slopes of the Pacific states. But already the southern timber is nearing exhaustion and that will leave us principally dependent upon the Pacific coast forests.

The timber-using industries are located mainly in the East and long before the vanishing point is reached in our timber supply, the shortage will be keenly felt in increased costs, as the timber supply moves farther and farther away from the demand.

It must not be imagined that the entire East is denuded of trees or that there is no hope of reforesting there. About 60 per cent of

(*Continued on page 73*)

**Another view of destructive lumbering in California's redwood belt**

## Fence Posts That Don't Decay

Forest Service model illustrating the new method of preserving fence posts

DECAYING fence posts are familiar sights on thousands of farms, and when probably several million feet of timber is involved, the problem of preservation is one of magnitude. Obviously, every farmer cannot operate an expensive wood-preserving plant which would afford artificial treatment of the posts before they are planted in the soil. How, then, can the resisting-qualities of fence posts be strengthened against the attacks of a low form of plant life called fungi—decay not due to the chemical action of the soil, as is popularly believed?

The diminutive model, as herewith reproduced, is descriptive of a novel method designed by the U. S. Forest Service whereby farmers can lengthen the life of their fence posts by a simple treatment. Obtain four abandoned barrels, two of which are to be connected with a four-foot iron pipe; the other two containers being disconnected but in close proximity to the twin barrels. Coal-tar creosote, a cheap brownish-black oil, is prepared as a timber preservative. Once the fence posts are seasoned they are soused in the connected barrels where the wood receives a hot bath. A fire built under the connecting iron pipe supplies heat for the liquid inside the two containers. The two isolated barrels likewise contain a coal-tar creosote preservative, the posts being transferred from the warm temperature to these containers where they are given a cold bath.

Having been thoroughly immersed in the artificial preservative, the farm timber is piled, chicken-coop fashion, for drying. The creosote treatment qualifies in the essential requirements as a preservative of farm timbers: namely, reasonably cheap, capable of penetrating wood, not easily washed out of the wood, and poisonous to the lower plant life which so insiduously pursues its tactics in breaking down fence supports. By giving the posts a hot bath the air and moisture in the timber expand and are partially expelled; when plunged into the two barrels containing the coal oil the remaining air and moisture contract and serve to draw the oil thoroughly into every fiber of the wood.

The time required in administering the simple treatment is largely gaged by the rapidity of penetration and the quantity of oil absorbed. Preliminary experiments suggest that the hot bath should not extend over three hours, with an equal period of time allowed for the cold bath. Seemingly paradoxical is the statement by the Forest Service that the most efficient treatment is the one affording maximum penetration of the substance of the wood, but with a minimum of permanent absorption of oil.—By *F. W. Hyde.*

A model designed to show the effects of tree cover in preventing the erosion of the land surface

## Geology and Forestry

AMONG the educational exhibits to be found by the visitor in Washington, few are of greater interest or value in their field than those which the Forest Survey has constructed to show the influence of trees and forests upon the action of various geological agents which have contributed to the making of the earth's surface what it is. An idea of the size and character of these may be obtained from the accompanying picture, which displays the model designed to show the effects on erosion of land surfaces. The immediate lesson which this model is intended to emphasize is the influence of trees in preventing erosion; hence the barren stretch which has been washed clean of all soil, and the tree-covered regions above where the destructive faculties of water have found little scope. Between the two areas in question there stands what is represented as a middle ground—temporarily. With its trees cut off and nothing standing on it but stumps, however, it is very plain to the most casual inspection that this section will take on the aspect of the lower level, and within a space of time which, geologically speaking, amounts to nothing at all. A better object lesson of the ultimate consequences of the indiscriminate deforestation which so large a part of the West has suffered could hardly be imagined.

The old road and the new at a point where a simple operation eliminated a sharp curve overhanging a steep bank on this much-used highway

## Ironing Out a Dangerous Curve

DANGEROUS stretches of highway are not uncommon but in the elimination of "Dead Man's Curve," on the Washington-Baltimore boulevard, near Elkin, Howard County, Maryland, there remains only a shameful memory of one of the most perilous roadway curves in the United States. Some six or eight persons met tragic endings while thirty-five more or less serious accidents were recorded before the change was made. The original curve extended for a distance of 1,150 feet, and automobiles being directed around the sharp turn were frequently driven over a steep incline or embankment. A vision blurred by the road was likewise frequently impaired by autoists imbibing too freely of intoxicants, when prohibition in Washington, D. C., drove them to Baltimore—all contributing to the menace of "Dead Man's Curve."

The State Roads Commission of Maryland authorized the elimination of the perilous stretch at a cost of $17,000—an insignificant consideration when compared with the toll of life which it annually exacted. The bank at the sharp bend in the road was cut away from the inside of the curve toward Baltimore, the soil being used in making a fill, thus straightening the western end of the dangerous stretch. The curvature at this point has been reduced from 110 to 60 degrees, facilitating an enlarged vision all along the changed location. The new slice of roadway is constructed of concrete and is 20 feet wide.—By *S. R. Winters.*

## Purple Dye from Shellfish

ON the Pacific coast of Costa Rica, especially in the region about Cocos Bay, there abounds a kind of shellfish called the "nacascol," from which a fine purple color is obtained. So far no way has been found for preserving this dye, and the industry has remained in the hands of the few old people who take the trouble to dye a few ounces of thread every summer. The process is very simple. On picking up the shell from the beach or detaching it from a bowlder, the gatherer blows her breath into it, whereupon a few drops of a greenish liquor ooze out. This liquor is collected in a clamshell, and after a sufficient quantity has been collected the thread is passed through it, very soon assuming on exposure to the sunlight, a beautiful purple color, which is absolutely fast after it has turned purple. It is thought possible that the dye turns fast only on exposure to the air and that the liquor could be preserved by keeping the air away from it. There is little doubt that this industry of dyeing thread could be extended to greater proportions if an extensive demand at good prices could be found for the dye-stuff.

## Protecting Peach Trees from Worms

THESE darkies are neither hunting for four leaf clovers nor practising for a revival meeting. They are worming peach trees in order to prevent the costly losses which result from the activities of peach tree borers. The earth is removed from around the crown of each tree to a depth of four or five inches and the trunk brushed or scrapped free of loose bark and dirt. The darkies armed with knives, stiff wires and suitable gouging tools locate and remove and destroy the borers which are fortified in their burrows. Special care must be exercised not to cut the sound bark or wood unnecessarily as carelessness may cause more damage than would result from the insects themselves. After the worming work is completed, the earth is mounded up around the tree to a height of 8 to 10 inches. The base of the tree is also often whitewashed to further protect the trees against peach borers.—By *A. R. Surface.*

A delicate job of cutting borers out of young peach trees

The 23-meter trial horse — Challenger: "Shamrock IV" — Defender: "Resolute"

**America's Cup racers of 1920**

# "Resolute" Defends the Cup

## Why "Resolute" Was Chosen and Her Prospects of Defeating "Shamrock IV"

### By J. Bernard Walker

ALTHOUGH a great many yachting enthusiasts will be disappointed that "Vanitie" was not chosen to defend the America's Cup, we are in a position to state that the selection of "Resolute" was made strictly on the merits of the two yachts. The Cup Committee realized that the challenger was too fast a boat to allow of any but the very best of our craft being sent on to the Sandy Hook course to meet her; and in trying out "Resolute" and "Vanitie" this year, there was never at any time a thought of playing any favorite—much idle talk to the contrary notwithstanding.

The proof that the Cup Committee was impartial in its treatment of the two defending yachts is to be found in the remarkable improvement shown by "Vanitie" since she came unreservedly into their hands. During the racing of 1914 and 1915 she seemed to be a hopelessly beaten boat; whereas by the close of the 1920 trials, she had several impressive victories over "Resolute" to her credit, and had proved to be so close a match for the Herreshoff craft that in any true wind, whatever its strength, the issue was in doubt until the yachts were over the finish line and the corrections for time allowance had been made.

Never in all the seventy years that have elapsed since the "America" sailed her historic race has a Cup Committee been confronted with a more difficult task in selecting the defending yacht, and the decision was arrived at only after an exhaustive analysis of the results in all of the 1920 trial races. In the first place, all races in which the vagaries of the weather vitiated the result were promptly ruled out of consideration; and a careful analysis was made of the relative performance under conditions when the wind and weather were equally favorable to both boats. Each leg of every course sailed was thus studied and the final choice was made on the total number of points scored by the two yachts. The outcome showed a slight advantage in favor of "Resolute."

To this must be added certain physical characteristics, the consideration of which scored in favor of the selected boat and marked her out as having that slight margin of superiority which might mean the difference between winning or losing. For it must not be forgotten that cup races have been won by 40 seconds, as in 1895 ("Vigilant" against "Valkyrie II") and by 41 seconds, as in 1901 ("Columbia" against "Shamrock II").

At the present writing "Shamrock IV" has shown such a decided superiority over the 23-meter boat that the races between the two have been discontinued and the crews of the boats are being trained in teamwork on the challenger. The failure of the older boat to push the challenger more closely is surprising; for in addition to the fact that in 1912 and 1913 she beat all competitors, winning on time allowance against larger craft and saving her time allowance against smaller boats, she is somewhat faster today than she was then.

This is due to the fact that she was handed over to Mr. Nicholson to make any changes he thought fit that would increase her speed as a trial horse for "Shamrock IV." To this end he added several tons to her lead and lowered its center of gravity. Like all boats built under the International rule, the 23-meter boat had a considerable rocker to her keel, which was 22 inches higher at the forward end than at the stern-post. As she now stands, the bottom of the keel is level. Several tons were cut from the ends of the old lead and this, with the additional lead, was molded on the bottom—the new lead tapering from 22 inches depth at the forward end to nothing at the stern-post.

The additional stability thus secured made possible a large increase in the sail area, so that with all her kites set, the 23-meter boat has nearly as much sail area as "Shamrock IV." She is also eighteen inches longer on the waterline—and length means speed. Her displacement today is 115 tons as against 106 tons for the challenger.

In spite of these changes the new boat, in a topsail breeze seems to be able to beat her about 12 minutes in a 15-mile turn to windward. In a run of 15 miles down the wind, she seems to have an advantage of two or three minutes.

In answer to the question why she cannot pull out a greater lead when reaching and running, we quote a remark of Charlie Barr to the writer: "Any old hooker can go fast down the wind; it's good windward work that wins races."

On the one occasion when the two Shamrocks were tried out in a wind sufficiently strong to call for lower sails only, the old "Shamrock" crossed the line slightly ahead and with the new boat tucked squarely under her lee. Under the stiff wind, the new boat, with her larger sailspread, showed in the puffs fully five degrees greater angle of heel, and both were smoking along at their top speed. "Shamrock IV" pulled clear and showed a gain of 2½ minutes in the six miles to the weather mark; the equivalent of 6¼ minutes in fifteen miles—a remarkable achievement, considering the high rate of speed. Coming home before a freshing wind she gained at the rate of 1 minute 40 seconds in fifteen miles.

And now as to the outcome when Nicholson, a new man in these International contests, meets Herreshoff off Sandy Hook. The 23-meter boat, under her 1912 trim, frequently made an even 12 knots on certain stretches of the course. She is somewhat faster today and "Shamrock IV" has her measure by a good margin on any point of sailing. But "Resolute" has frequently made 12.25 knots for several miles on end.

Let us suppose that "Shamrock" has to allow "Resolute" six minutes over a 30-mile course, say to windward and leeward, and that "Shamrock" barely saves her time—the weather conditions being such as bring out the best speed of both boats. Let us suppose

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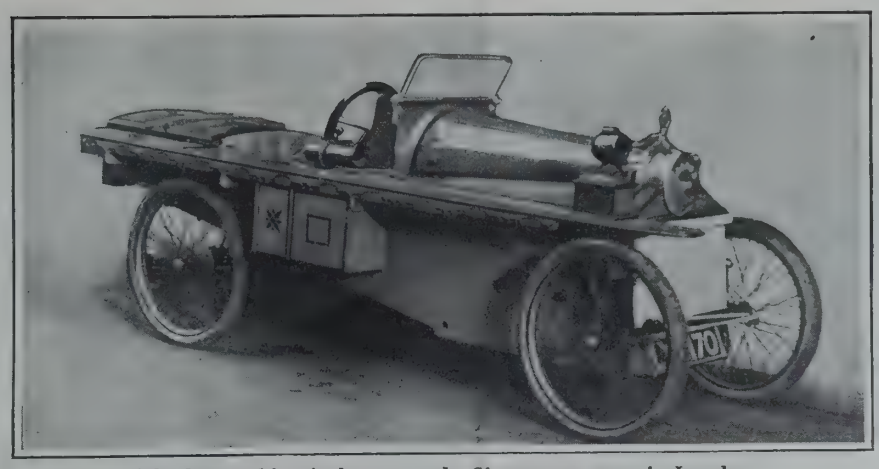
All photos copyright, Morris Rosenfeld, N. Y.

**Close-up view of the deck of "Shamrock IV," when she was close-hauled on the starboard tack**

## The Home-Made Car

THE mechanically-inclined young chap who insists on making all his own things is always with us. In the old days he used to make his own bob-sled and his own racing sulky and above all his own sailboat. Then the gas engine came in, and he began making his own motor boat and before long even his own engine. Today he is busily engaged in assembling his own automobile and his own airplane. Wherever we go, we see among the vast concourse of big and little cars of standard makes a few of these low-hung, spider-webby affairs built to accommodate an engine and as much of the anatomy of a speed-maniac as can be crowded into them.

Much attention was recently attracted in the streets of London to the home-made speed bug which we illustrate herewith. The owner and builder seems to have had a talent for pattern-making as well as for machinery, and has made his body of hard wood, picturesquely carved and decorated. The engine and the assembly of the various moving parts presents no feature of startling novelty, although as little cannot be said for the position of the mud-guard. Another ingenious stroke is the use of an ordinary window shade on a roller to prevent the radiator from doing too good a job and cooling the engine below the point of best operation.—By *Ralph Howard.*



The latest thing in home-made flivvers, as seen in London

## Sea Gulls Make It Necessary to Cover Reservoir

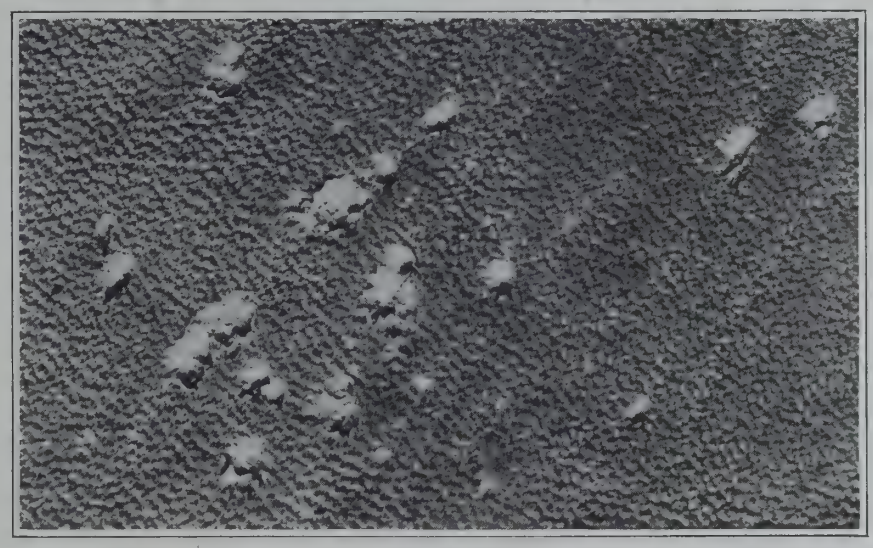
THE reservoir of the California water company shown in the accompanying photograph was built in the 50's, but recently because of the sea gulls' becoming such a nuisance it became necessary to cover it. The reservoir has existed for all these years within a few blocks of San Francisco Bay, but apparently was not discovered by the sea gulls until the latter part of 1918, when all at once they began to infest it, making it necessary to place guards around it to frighten them away—it was against the law to injure or kill them. What caused the gulls to seek the reservoir is a mystery. They came in such numbers that it was finally found necessary to cover the reservoir. With the completion of the roof over the reservoir a few months ago, the gulls departed as suddenly as they came. The reservoir supplies drinking water to certain sections of San Francisco, and for this reason it was necessary to take this course of action.—By *C. W. Geiger.*

San Francisco's reservoir that had to be covered to protect it from the sea gulls

## What the Cattle Tick Does to the Hide

THE educational activities of the Department of Agriculture have made it pretty generally understood that the discomfort suffered by an animal that is infested with fleas or other parasites is by no means the end of the matter—that the financial damage suffered through the deterioration of the creature's general tone by this discomfort, and through the actual physical ravages of the parasite itself, often make it well worth the raiser's while to spend time and money in the effort to free his flocks or herds of the objectionable guests. The photograph which we show herewith affords a striking illustration of this.

The cattle tick, of course, is known by all of us to be an insect pest that lives by sucking the blood of its bovine hosts. But perhaps it does not always occur to us that the skin of a full-grown bull or cow is a decidedly formidable affair, that in order to penetrate this skin and get to the place where the blood is to be found the tick has to do a good deal of excavating, and that when it comes to making leather of the victim's skin the marks of this excavating offer an obstacle. As a matter of fact, the holes made by the ticks in their search for nourishment are responsible for a reduction in market value that averages two dollars for each tick-bitten hide. The extent of the damage may be better understood from examination of the photograph.—By *A. R. Surface.*



What the hide of a bull looks like after the ticks have done their work

Berlin establishment in which clothing for the needy is made from discarded military articles

## Plastic Dressing for Wounds and Burns

INDUSTRIAL plants are now using the ambrine treatment for burns, scalds, and all surface wounds which proved very successful for casualties incurred in the world war.

The dressing is a compound of wax and resins, and is solid when cold. It is heated to about 150 degrees Fahrenheit, and applied by means of a special atomizer, or it can be gently daubed on with a soft brush. A plastic dressing, impervious to air, is thus formed, which does not adhere to the wound and which promotes the healing process without appreciable contraction. Disfigurement and scars are prevented to a greater extent than was possible under the old methods.

The outfits can be purchased in two sizes at $17.50 and $47.50 each, and will no doubt be found valuable in first-aid dressing in metallurgical plants, particularly for burns.

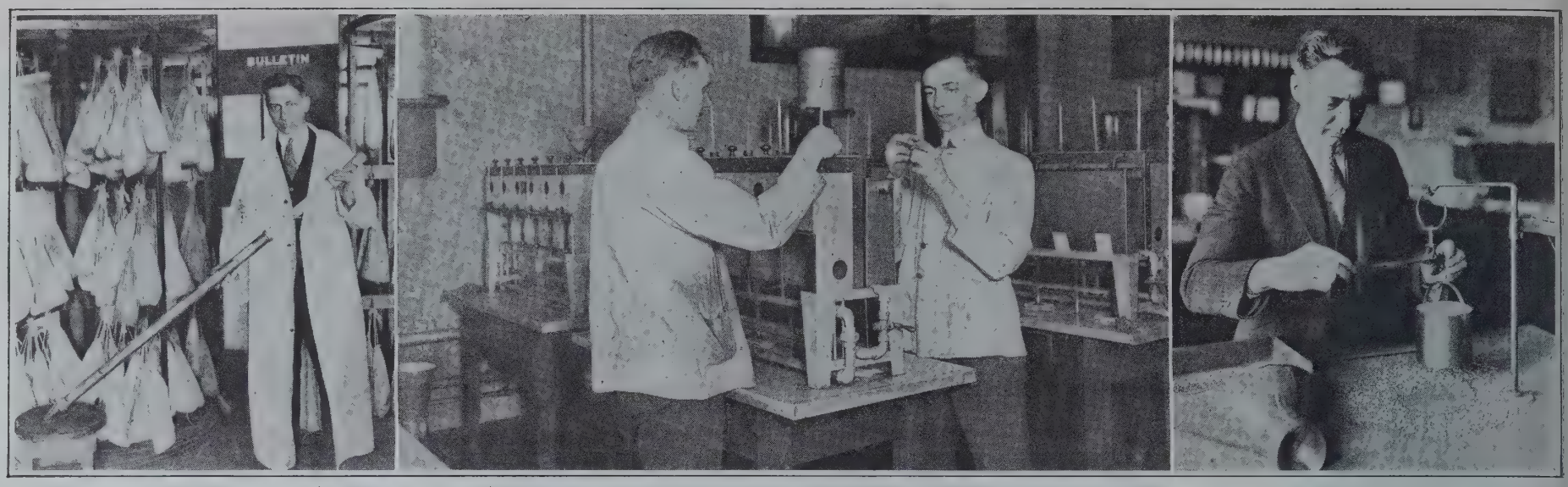
## Gas Masks in Pulp and Paper Mills

GAS masks of a nose-breathing type with canisters containing special chemicals are used in the digester house of the Forest Products Laboratory to give protection against sulfur dioxide. These masks enable the operator to make repairs under conditions otherwise unbearable and soon pay for themselves in time saved. Masks of this type are reported by the Bureau of Mines to hold up against a 5 per cent concentration of sulfur dioxide for about 15 minutes. When it is realized that 5 parts of sulfur dioxide to one million parts of air can readily be detected, and that at a concentration of 150 parts of sulfur dioxide to one million parts of air the air becomes unbreathable, some idea can be gained of the life of a canister even under adverse mill conditions.

In addition to their use in the sulfite mill, these masks are of great assistance in the bleach room, where they are worn continuously during the mixing of the bleach liquor. Aside from monetary considerations, the increased comfort and safety of the workmen is sufficient argument in favor of the addition of gas masks to the regular mill equipment.

## Working Over the Salvage Pile

THE salvage of discarded army supplies was a game which, as everyone knows, was freely played in France during and immediately after the war; but it may surprise some to learn that it is still being done in Germany. The workroom shown in our photograph was established in Berlin early in the war in the interests of the unemployed, who were here set to work renovating worn-out uniforms, shoes, etc. It has been continued, and others opened, not so much for the sake of making employment as to render it possible for the worst-hit of the city's poor to be clothed. In these shops about a thousand persons, mostly women, are now engaged working over the discarded clothing, hospital linens, gas masks, etc., into wearing apparel and other useful articles, which are sold at rock-bottom cost prices to the people who need them most. The position of those unfortunates whose income has remained practically fixed and who have not the ability or the enterprise to supplement it from irregular sources is so desperate in Germany today that but for measures of this sort it would not be possible for them to exist. When it takes a year's earnings to buy a semi-respectable suit of clothes, anything in the way of a substitute is more than welcome.—By *James Anderson.*




*Left:* The trier used to take samples of grain from the cars, and a wall-full of these samples, each in its bag. *Center:* Reading a moisture test; the graduate in the hands of the right-hand operator contains the moisture that was cooked out of a sample of corn. *Right:* Weighing the uncooked sample to check against the weight of moisture extracted from it

**How grain arriving in Chicago is sampled and tested to see that it is up to grade**

# The Man Behind Our Daily Bread

## Grading and Testing Grain for Sale on the Grain Exchanges of the Country

### By Robert H. Moulton

IF you visit one of the large grain exchanges of the country, like the Chicago Board of Trade, for instance, you will see on the trading floor long lines of tables on which are numerous small paper bags containing samples of grain. You may or may not know that these samples came from cars in the freight yards of the city where the exchange is located, and that they are used as a medium by which the entire carload lots are sold and bought. But concerning what happens to these samples before they reach the exchange you are apt to know nothing whatever. As a matter of fact, even the average farmer who raises wheat, corn, oats or some other grain, and who is therefore the person most concerned, has little idea of how his grain is handled after it is shipped from the farm and reaches a terminal market.

Before the samples of grain are displayed for sale on the exchanges they must pass through an intricate process of grading and testing according to rules formulated by the Federal Government. Each state in which the big terminal markets are located, such as those at Chicago, Omaha, Minneapolis and Kansas City, has an official grain inspection department whose duty it is to grade and test every car of grain arriving at that market. By "grade" is meant the quality of the grain as established by the Bureau of Grain Standardization of the Department of Agriculture. Thus, both wheat and corn have six grades, ranging from the best to the poorest, which accounts for the fact that one farmer may receive a better price for his wheat or corn than a neighboring farmer who shipped a similar lot of grain to market at the same time. One may grade high and the other low, and this naturally affects the price paid for it by the grain dealer who buys it through the commission men on the exchange. This difference in price may amount to several cents a bushel.

Practically all of the grain raised in the United States except that used for local consumption is sold on the exchanges. The reason for this is that these institutions furnish a world market. The exchanges themselves do no business, but merely provide a place where buyers and sellers the world over, through their representatives, may meet and trade. In doing so, they perform a valuable service to producers and consumers alike. Most of the grain produced in the United States must be handled within a few months. This means that about one billion bushels of wheat, three billion bushels of corn, and one billion bushels of oats, besides smaller quantities of rye, barley, etc., must be distributed evenly. If there were no machinery for this purpose, there would be hopeless congestion followed by long periods of dearth. The grain exchanges for the country furnish such machinery On the Chicago Board of Trade alone more than 400,000,000 bushels of grain are bought and sold each year. This refers to "cash" grain.

*THE housewife who buys food for a large family knows well that only in eternal vigilance is to be found the road to safety. She is well aware that if she does not scrutinize with care everything that she selects, and scrutinize with equal care everything that is delivered to her, she will not get the best grades. She knows that most of the merchants with whom she deals must as a means of avoiding loss sell the seconds and the goods that have got stale or wilted since receipt, and that they will land her with her share unless she is prepared to meet them on their own ground. How, then, she might ask, could she ever be sure of getting what was coming to her if she had to bargain for her purchases weeks and months ahead, without ever seeing them, and if she had to accept delivery from a fifth or sixth assignee of the sales contract which she had signed so long ago? Unless some satisfactory answer to this question can be framed, it must remain a mystery how the grain exchanges, which do business on precisely this future basis, are able to exclude crooked work from their dealings. In this story Mr. Moulton tells us how it is done, how the buyer knows when he contracts for grain just what is coming to him, and how it is made certain that he gets it.*—THE EDITOR.

Now "cash" grain might mean little or nothing to the outsider, but to the man in the trade it means grain intended for immediate delivery; that is, grain which is actually in cars or elevators in the terminal markets, and which can be delivered immediately to a purchaser. There is another department in which grain is bought and sold for "future delivery" but that is merely another chapter of the same story.

The Illinois State Grain and Inspection Department, which prepares samples of grain for sale on the Chicago Board of Trade, has frequently handled more than 30,000 cars of grain in one month, and its record for a single day's work done is 2,520 cars, of which 1,472 were corn. The latter is more difficult to grade than any other grain, as it requires the moisture test recently established by the Federal Government. The offices of the Grain Inspection Department in Chicago employ 25 deputy inspectors, 50 grain samplers, and a large clerical force.

Early every morning the grain samplers go to the freight yards where cars of grain have arrived overnight and take samples of each car. The sampling is done by means of an instrument known as a "trier," which consists of a 2-inch metal pipe 6 feet long, with a pointed end, in which are cut, at intervals of five inches along one side, eight holes about 4 inches by 1½ inches. A smooth wooden pole fits snugly into the pipe, closing all the holes. In using the "trier" it is shoved into the grain, down to the bottom of the car, and the pole is then gradually withdrawn, opening the holes, and allowing the grain to enter the pipe from various openings in the trier. The sampler is thus enabled to get a sample that will determine whether or not the grain in the car is all of one quality.

The sample thus taken is placed in a cloth bag together with a ticket on which is marked the initial and number of the car, and a notation showing the condition of the car at the time the sample was obtained. These sample tags are carried to the offices of the State Grain Inspection Department and the grain therein is inspected and graded by expert graders. A grain inspector must possess good eyesight, a keen sense of smell and a very acute sense of touch. These qualities are of vital importance, especially in the inspection and grading of wheat. The inspectors are all men of practical experience in the grain business who have passed rigid civil service examinations under the supervision of the Illinois State Civil Service Commission. These men stand before large tables on which the sample bags are placed. The inspectors open the bags and pour the grain into pans especially made to receive the contents of the bags. These pans are provided with funnel-shaped ends so that the grain may easily be poured into the

(Continued on page 74)

**The Illinois State Grain Inspection Department, where the work of sampling and grading of grain is done**

## The Akron-Detroit Dirigible Express

A BIG step forward in the development of commercial aviation in the United States is about to be taken by one of the big mid-western rubber concerns, which has purchased a Chalais-Meudon dirigible from the French government, and plans in September to establish the first inter-city airship line. Daily round trips will be made between Akron, the headquarters of the rubber industry and a place which most of us are only now learning in the light of the census figures to recognize as a city of the first class, and Detroit. For the first month or so, while the route and the ship and the navigators are being tried out, it is planned to carry only mail and express; after that it is probable that a passenger service will be attempted.

The airship to be employed has 320,000 cubic foot capacity, is 260 feet long and motored with two 250-horse-power engines which will drive it at a maximum speed of about 50 miles per hour. The cabin is 45 feet long, and when changed from its present war-time design to that of commercial construction it will accommodate about thirty passengers.

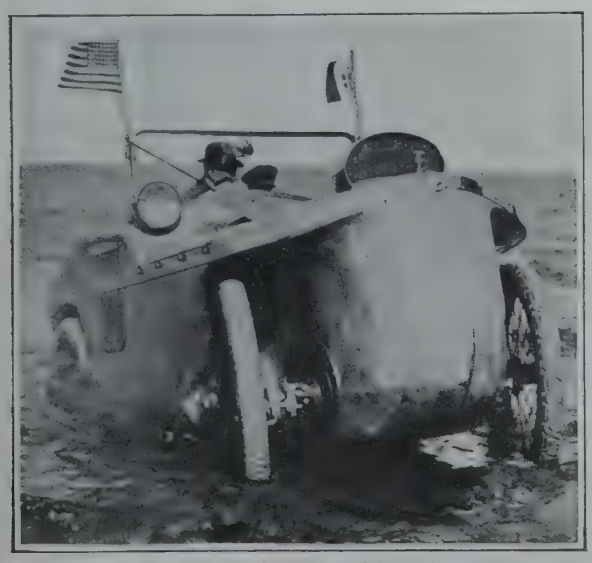
This ship was built for use in the war, of course, but was completed too late for service. No time schedule has been made up for the 150-mile trip between Akron and Detroit, but it will of course be much faster than the rail trip. The former United States Navy air station at Wingfoot Lake, Akron, has been secured for one terminal, and pending the arrangement of suitable housing in Detroit it is anticipated that a mooring mast will be used. Surely two cities with more interests in common than the automobile and the tire centers of the universe could not have been selected for this first effort at regular commercial airship communication—nor two cities whose present facilities for communication are more in need of improvement.

## The Sea-Going Automobile

WHAT with the hydroplane and the flying boat, we have a multiplicity of machines that are designed to discharge more or less satisfactorily the dual function of airplane and motor boat. But what shall we say of the bold constructor who puts forward a combination of automobile and speed-ship?—a motor car-boat, perhaps we may call it.

The interesting machine which is illustrated herewith is the "Sirena," and is now on exhibition at Atlantic City. It is a fully equipped motor car capable of making the speed of sixty miles an hour, anything less than which is today unworthy of the term of speed in land propulsion. It differs in design from the conventional car mainly in the very substantial bottom, the reason for which is immediately apparent when we reflect upon its secondary use; the ordinary carburetor, magneto, etc., would hardly function to the satisfaction of a particular driver if the car in which they are mounted were submerged to the gunwhales, and the spark-plugs might likewise have something to say about this semi-aqueous mode of operation. However, with the cruiser bottom with which this machine is supplied, she takes the water very nicely. A simple clutch throws the transmission off the wheels entirely and starts the engine to driving a propeller at the rear of the body—which, believe it or not according to your individual predilection, the maker assures us is absolutely watertight. As a boat the strange combination is capable of a speed of 20 knots. For those who insist upon sedan or limousine, the manufacturers say that they expect shortly to have such models.

We do not know just how popular this idea is going to be with the tire manufacturers, but perhaps if the front-wheel suspension will stand it the tires can be lepended upon for good performance.

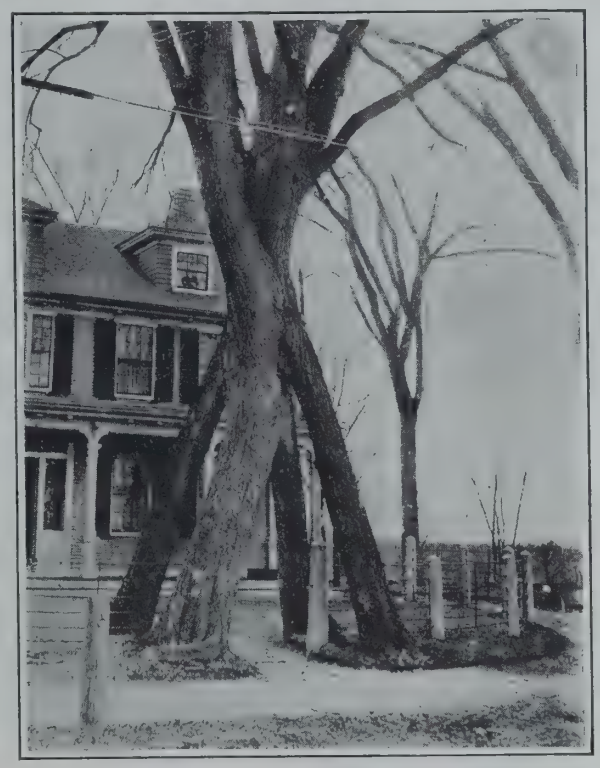


**An automobile on land—a speed boat in the water**

**The airship of French design with which it is planned to start regular service between Akron and Detroit**

## A Tree with Four Legs

NATURE has produced many freak trees, but one of the oddest forms ever created by human action is a four-legged tree standing at the entrance to the home of a Bridgewater, Mass., man. This tree has all the appearance of a single tree trunk with four spreading legs. As a matter of fact, the trunk is the combined trunks of four white elm saplings planted in a group and bound closely together about twelve feet from the ground, a good many years ago. In time the trunks grew into one, and this strange arboreal quadruped is now a large and sturdy tree. It is known locally as the "wishing tree," the legend running that a wish made while one is walking in and out among the four legs will come true.



**Demonstrating that a quadruped is not always an animal**

## Wood Firing on European Locomotives

IN Sweden, as in Switzerland, because of the fuel shortage, as a temporary measure, locomotives had to be fired with wood. The experiments made in the latter country were comparatively successful. The start was made on the Bodensee-Taggenburg Railroad, where steam was got up by means of wood firing, resulting in a pressure of from 5 to 6 atmospheres derived from one cubic meter of wood. Not only was the cost fifty per cent less than that of a similar quantity of coal, but the time required for getting up steam was shortened. Consequently firing by means of wood was instituted for the trip; but difficulty was encountered in finding sufficient room for the amount of wood needed. Finally, special cars were added to the trains to carry the wood.

The wood is cut into blocks and burned the same as briquettes. The same high class service resulted as if coal had been used. Four square meters of first class beech wood or five cubic meters of mixed wood (beech, pine, etc.) were about equivalent to one ton of first class coal. An average train required 152 tons and 68 cubic meters for 1,000 train kilometers; 16 tons of coal would have been required for the same trip.

Because of the high price of coal in Switzerland during the war, the firing of trains by means of wood proved to be an economic success. A disadvantage lay in the stream of sparks caused by the burning wood. The addition of pitch, which possesses from 7,500 to 8,000 calories of heat, is quite successful.

## Dehydrating Crude Oil Electrically

CRUDE oil often contains water which must be removed and this is not always easy. The usual methods are the application of heat, centrifugal force or chemical action. A new method is by the use of electricity which has proved superior to the others.

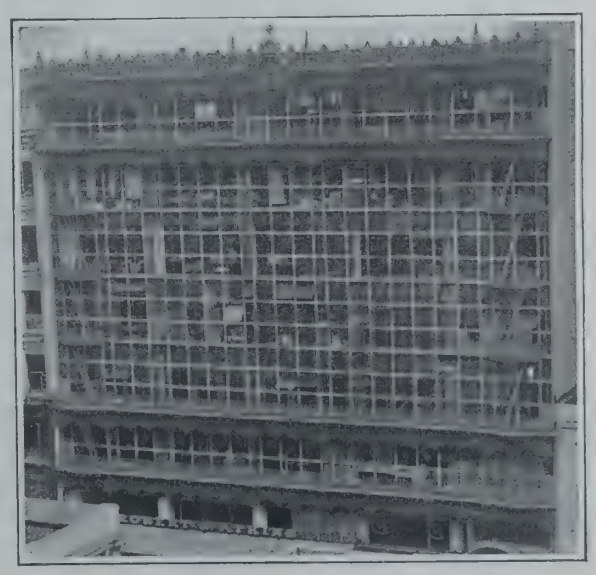
When present in the form of large free globules, water will settle out from oil by gravity, but if the water is in a state of emulsion with the oil, it will not settle out at normal temperatures and pressures, even if the mixture be allowed to stand indefinitely. The removal of water at the well effects an important reduction in freight costs, besides eliminating the clumsy practise of allowing purchasers a rebate on the percentage of water which they were able to prove was contained in the crude oil hitherto delivered.

There are 17 electrical dehydrating plants now operating in the Whittier District in California, and in many cases oil hitherto unfit for use is made marketable by electrical dehydration. The oil treated ranges from 15 to 50 per cent of water, and the consumption of electrical energy is about one kilowatt-hour per 18 barrels of dry oil. The electrical dehydration causes practically no loss of gasoline, and the gravity of the oil is raised one or two degrees by the treatment. This increases the value of the oil sufficiently to pay all or part of the cost of treatment. The heating process, on the other hand, involves more or less deterioration of the oil. Careful tests indicate that, under the same conditions, the heating process costs 7.5 cents per barrel, compared with 1.5 cents per barrel (or 2 cents, including royalty) for the electrical process.

Usually, the electrical dehydrator operates on single-phase alternating current at 11,000 volts. The emulsion of oil and water is passed between highly-charged electrodes, and the effect of the electrostatic field is to coalesce the particles of water and also coalesce the particles of oil. The water then settles readily by gravity. The average maximum demand per dehydrator is 4 kilowatts, the average load factor 50 per cent, and the average power factor 98 per cent leading. In districts where water is scarce, the water separated electrically has considerable value.

## People Who Live in Glass Houses

IF there is anything in the old saw, the proprietors of this big clothing store in San Francisco will have to be very circumspect with regard to the hurling of missiles. They boast that their street-front is "all glass," and it comes about as close to justifying the claim as any type of construction that we have ever seen. It is to be hoped that the Golden Gate does not become the scene of a repetition of New York's "Black Tom" explosion, which blew out windows twenty miles away—if it does, we can see where there will be work for the California glaziers. But even such a disaster might be a fair price to pay for the extraordinary lighting which the interior of this building must enjoy.



**A San Francisco store with an all-glass front**

# The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

*This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles*

**A short cut from digging bucket to truck**

## Economical Truck Loading

THE illustration herewith shows a five-ton truck of standard make used by a contracting firm in Cleveland, and shows how a simple and rough hopper structure can be utilized in loading motor trucks economically when these are employed in hauling away excavated material. As will be evident from the illustration, the hopper is loaded by the usual form of clam-shell excavating-bucket, which in this case is handled by the conventional form of steam-operated derrick boom. The hopper, which has a capacity for several truck-loads of material, is carried on substantial columns of such height that it is an easy matter for the truck to back down underneath the loading chute. The floor of the hopper is inclined sufficiently so that as soon as the hopper gate is opened the material will drop down the chute into the truck body. It will be apparent that trucks may be loaded as fast as they can be driven under the chute. The surplus capacity of the hopper makes it possible for the clam-shell bucket to discharge its load even if there is no truck waiting to receive the material.

## Improved Type Combination Farm Body

THIS body is of the combination stock-and-grain type of especially heavy construction. The bottom panel is 14 inches high, being built solid to the body. As illustrated in the photograph the stock rack, which is 50 inches high, is constructed to be lifted off by one man, either in sections or as a unit. When off, this rack is replaced by a 10-inch grain panel which is shown in the photograph. This forms a solid grain body. The stock rack is equipped with a hog gate in the rear which can be entirely removed if desired. The sills and sub-sills of the combination body are constructed entirely of heavy kiln-dried oak, while the panels are built of genuine yellow poplar.

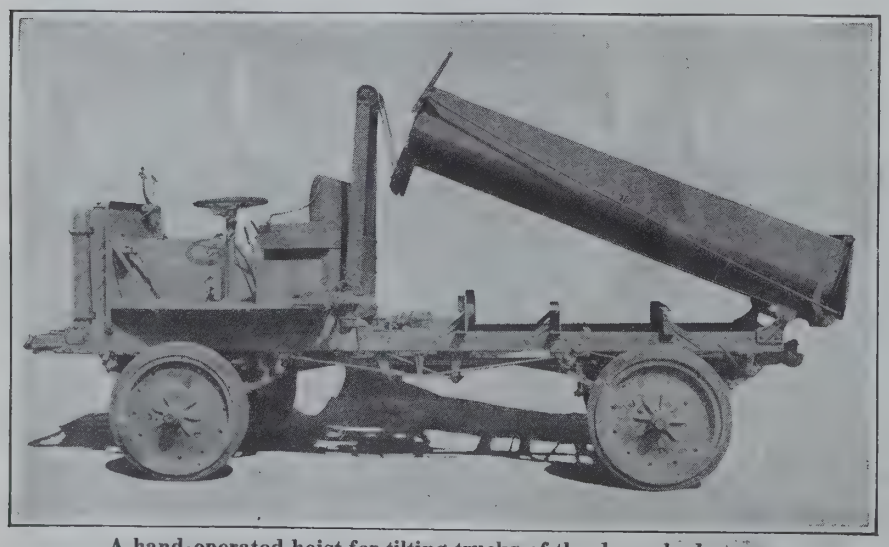
## Draw-Bar Pull of Trucks

ILLUSTRATIVE of the pulling power of the motor car over the horse, the Labor Day parade of a decade ago was not complete unless one float consisted of an automobile, dragging a trailer on which a dejected horse or two were trying hard to maintain their equilibrium. Now is presented the picture of the pulling power of a motor truck, which towed a huge freight locomotive for two city blocks without any difficulty. It was a five-ton truck that did the trick and the place was Seattle. The demonstration of pulling power was arranged

**Showing what a truck can do**

as the result of a wager between the division freight and passenger agent of the St. Paul Railroad and a prominent automobile enthusiast.

The locomotive's weight was 309,480 pounds and the truck weight less than one-thirtieth as much. To give the truck traction it was loaded with nearly five tons of cement and was then backed to the front of the engine. Heavy chains were used from the draw bar of the locomotice to the truck frame. The skeptical one signaled the start and the truck moved forward. There was an instant's halt as the dead weight of the locomotive resisted movement and then the steam engine began to move slowly. The rest of the two block tow was naturally uneventful, the engine following the truck easily enough after the initial resistance of starting was overcome.



**A hand-operated hoist for tilting trucks of the dump-body type**

**Combination body that serves all purposes about the farm**

## Heavy Duty Tractor

ILLUSTRATIONS have been presented from time to time in these columns to demonstrate the utility of the various forms of tractors and semi-trailer outfits in hauling large loads of various classes of material. The accompanying illustration depicts a semi-trailer outfit owned by a San Diego, California, produce company, which operates about the city carrying big loads of produce that come in by boat and train to the commission houses. One of the big advantages of the use of the tractor and semi-trailer outfits similar to that illustrated is that it is not only possible to handle large loads but that the trailers are

**The semi-trailer in close quarters**

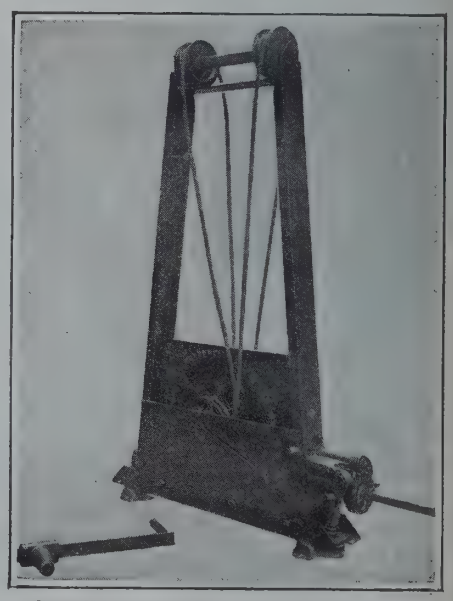
very easily maneuvered in congested spaces that are so often found around docks, factories or warehouses. It is easy to handle the heavily loaded trailers by maneuvering the tractor, in fact heavy loads can be moved much more easily than can be done with either horse-drawn vehicles or the conventional types of motor trucks of sufficient capacity to carry the loads.

## Hand Operated Hoist

A VERY simple and useful device that can be fitted to any motor truck is illustrated herewith. This is a hand-operated hoist that is used for tilting bodies of the dumping type. The hydraulic hoist as ordinarily used on motor trucks depends on the engine power for its operation and is somewhat too costly for installation on trucks that are used only intermittently for dumping purposes.

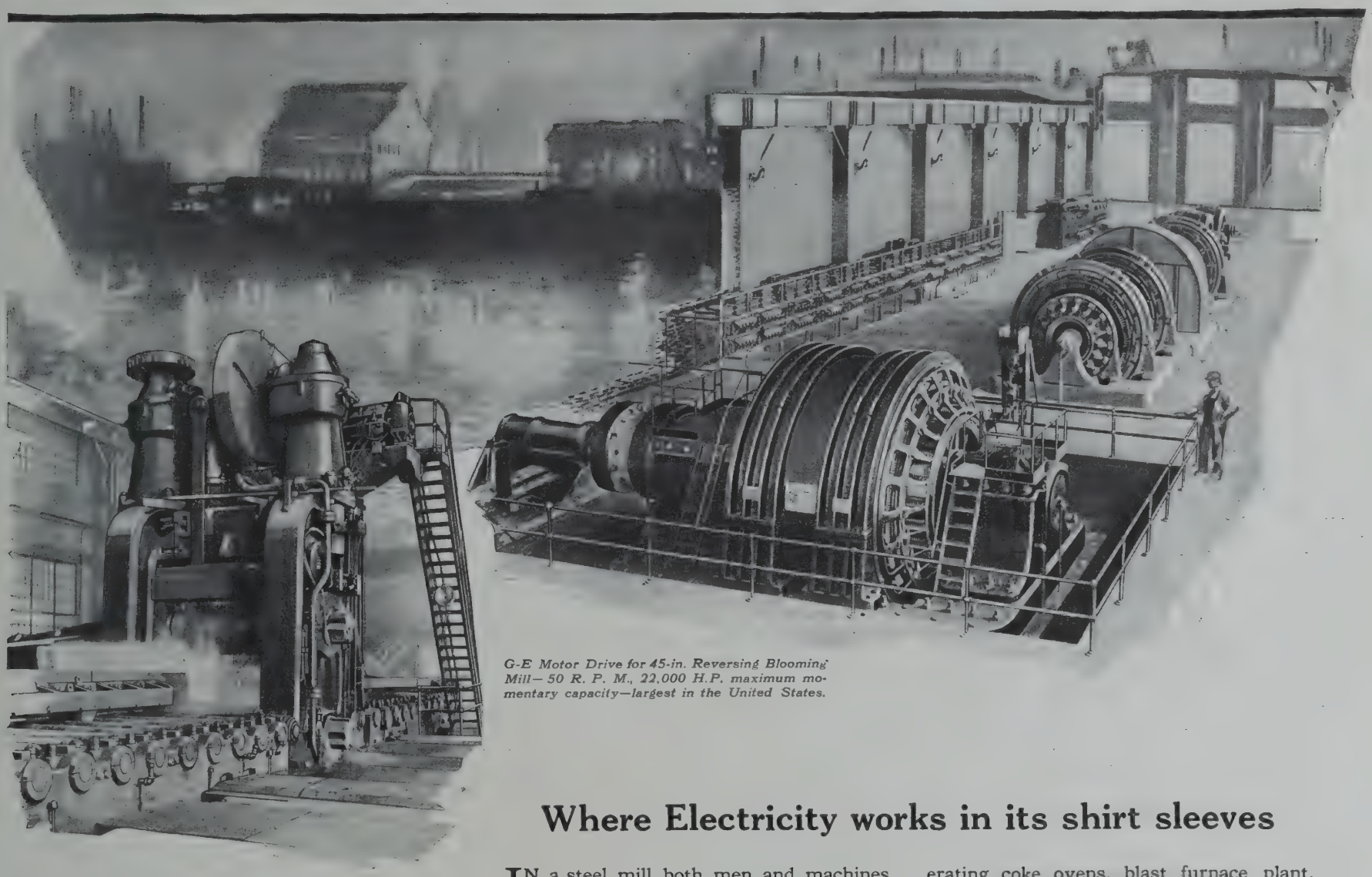
The hand-operated hoist may be obtained as a complete unit and is readily installed on any motor truck chassis as indicated. It is a substantial affair of structural-steel channel-section members and plates which completely enclose the actuating gearing. It is provided with pads at the base by which it may be securely attached to the motor-truck chassis by means of special U-bolts which encircle the pads and the motor car frame. The body and lifting cables are attached to arms which are furnished with the device and which are bolted to the front of the body. The body is hinged on the rear end and is provided with a hinged tail gate which may be controlled from the front end of the body by a suitable lever and rod connection.

A feature of interest is the form of crank provided, which is adjustable so as to secure various ratios of leverage, depending upon the weight to be lifted. The crank arm slides in a special member which is attached to the square end of the shaft operating the gearing. It is held in place in this socket by a pin, which can be set into any one of the holes provided along the length of the crank arm. An automatic ratchet is used so there is no possibility of the hand crank's reversing its direction of rotation due to the load lifted. The gearing is simple and provides a good leverage. The cables, which are attached to the lifting arms on the body, pass over sheave pulleys to a specially formed winding-drum of the winch mechanism on the base of the hoist.



**Details of hand-operated tilting hoist**

*The unlimited adaptability and easy control of electricity stimulates the development of great and small machines which mark the achievements of industrial progress*



*G-E Motor Drive for 45-in. Reversing Blooming Mill—50 R. P. M., 22,000 H.P. maximum momentary capacity—largest in the United States.*

## Where Electricity works in its shirt sleeves

IN a steel mill both men and machines must put forth the best that is in them—strength, endurance, speed, accuracy—all these are essential in either case. And the electrically driven machine has qualified for the hardest job of all.

As the white hot ingot of steel is carried on rolls back and forth under the blooming mill, it is literally squeezed into a bar, which grows longer as it grows thinner, and finally passes along to the bar mill. The blooming rolls must not fail, since production is so largely dependent upon their continuous performance—therefore G-E reversing motors are assigned to this strenuous task.

In other parts of a modern steel plant, G-E motors shoulder the heavy burdens just as faithfully—unloading coal and ore; operating coke ovens, blast furnace plant, open-hearth plant, sheared-plate mill, universal plate mill, and sheet and tin-plate mill. In one plant the installation of electric motors—the majority of which are G-E—totals 240,000 horse-power.

Where electric motors replace steam or hydraulic power, they occupy less space, are controlled from a central point, require in nearly every instance only one operator, and produce greater tonnage at a lower average cost—as proved by actual installations under various working conditions. The many advantages obtained through the use of G-E Motors and Control are at the disposal of all who invite the co-operation of the General Electric Company's steel mill specialists.

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# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

### Pertaining to Aeronautics

AIRPLANE.—H. C. NEAL, c/o H. T. Green, Philadelphia, Miss. An object of the invention is to provide an airplane embodying a construction whereby the airplane acts as a parachute in the event that the engine stops, so that the aviator may safely land on the ground. A further object is to provide mechanism capable of adjustment and operation while the machine is in motion to enable the airplane to remain in substantially one position to facilitate observations, or to remain vertical or in its normal position, when standing on the ground, and while in motion.

### Electrical Devices

ELECTRIC MOTOR.—L. FOOTE, Paraiso, Canal Zone, Panama. This invention has for its specific objects the provision of a field structure in which two rings or cylinders of the same diameter are arranged and a common axis, there being spaced teeth on the meeting edges of the rings, all the teeth of one ring being of one polarity and those of the other of opposite polarity, and the rings are so arranged that the pole teeth of one ring extend into the interpolar spaces of the other ring, whereby a plurality of closely arranged alternate poles are produced.

ARC-CURRENT REGULATOR.—J. A. HOLIFIELD, 1300 Church St., Mobile, Ala. The invention has for its object to maintain a substantially constant current within the limits of voltage desired for the arc in question. The invention is of special value in the arc of electrical welding as it is adapted to maintain constant current in the arcing circuit at all times without the presence of dead resistances and will function in an ideal manner to make a weld without burning places, globules or pitting.

### Of Interest to Farmers

AUXILIARY FLOOR FOR THRESHING MACHINES.—G. B. LUNDY, Niagara Falls South, Ontario, Canada. The invention has for its object to provide means for catching the falling grain from the feeder of the thresher, and wherein means is provided in connection with the said means for permitting the contents of the first sheet to be emptied into a particularly closed receptacle for convenience in dumping the same.

### Of General Interest

COMBINED BATHTUB AND DRESSER FOR BABIES.—E. L. NICKELS, 1243 W. Center St., Rochester, Minn. The invention has for its object to provide a device of the character specified; especially adapted for the use of babies, wherein the bathtub is built in the dresser, which is provided with a sliding top for covering the bath, capable of being slipped aside to provide a supporting surface for the baby after it has been bathed; the dresser also being provided with means for holding supplies.

SAFETY CATCH FOR BROOCHES. — B. BOCCACINI, c/o Tiffany & Co., 5th Ave. and 37th St., New York, N. Y. This invention relates to articles of jewelry or the like, and has particular reference to safety catches for coöperation with the pin portion of brooches, breast pins or emblems to prevent the accidental or unauthorized opening of the pin from its holding catch. More especially the device comprises a pedestal or frame made of any suitable quality of material such as sheet-metal and so stamped and folded as to provide not only a seat for the pin but also a space between the seat in which is pivotally mounted the keeper.

COOKING UTENSIL.—L. ARMBRUSTER, 510 W. 134th St., New York, N. Y. This invention relates to a cooking utensil; the aim is to provide a device wherein fluids such as milk may be brought to a temperature just below boiling without any danger of the same overflowing the side walls of the utensil, or scorching, as is now the case.

SUPPORTING LEG FOR WASHTUBS.—T. S. CASNER, 768 Kensington Ave., Plainfield, N. J. The invention particularly relates to a detachable leg for supporting a tub in elevated position. The object is to provide a detachable tub leg of simple and efficient construction, having means associated therewith for rigidly gripping and supporting the tub, which is adjustable to accommodate tubs of various heights.

WRIST WATCH HOLDER. — E EISENDECHER, Ultramares Corp., 280 Broadway, New York, N. Y. An object of the invention is to provide a device, which when the wrist watch is in position thereon, will have the appearance of a clock, or for display purposes. A further object is to provide a device which provides an elevated mounting for a wrist watch and bracelet or strap, and a centering recess to hold the watch in proper position.

REINFORCED CONCRETE FLOOR CONSTRUCTION.—D. J. FLYNN, 190 George St., New Brunswick, N. J. The object of the invention is to provide a reinforced concrete floor construction, reinforced longitudinally and transversely to render the floor exceedingly durable. Another object is to provide a floor with voids thereby making the floor exceedingly light. A further object is to permit of conveniently and quickly forming the floor without requiring highly skilled labor.

LUMINOUS THERMOMETER.—G. P. PITKIN, Bergenfield, N. J. The invention has for an object to provide a thermometer which can easily be read in the dark. A further object is to provide an attachment which can be placed on any ordinary thermometer tube and which will disclose the position of the expansible column in the dark as well as in the light.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. This invention has been granted two patents on alloys formed from copper, nickel, iron and zinc, under the influence of chromium or tungsten. The objects of the inventions are to provide an alloy characterized by having a high acid resisting quality, an increased density, an exceedingly close and fine grain, great tensile strength, increased elasticity and electrical resistance. The alloys consist of copper 50 to 60 per cent, nickel 26 to 34 per cent, iron 4 to 8 per cent, zinc 7 to 11 per cent, and .25 to 5 per cent of tungsten or chromium.

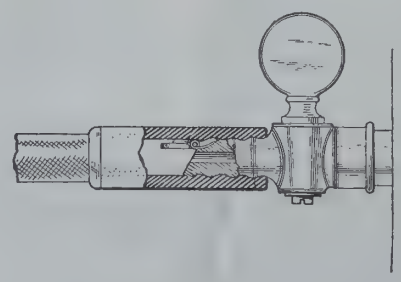
### Hardware and Tools

ATTACHMENT FOR WRENCHES.—L. A. BANTA, A.A.F.C., 36, Fellows, Cal. An object of the invention is to provide an attachment tool for socket wrenches which may be used in connection with socket wrenches for expediting the removal of cap screw bolts. It is a purpose to provide a tool of this character which will find a broad range of convenient uses in and around automobiles during the assembly and disassembly of the parts, and in other mechanical operations.

WINDOW LOCK.—R. BELLINGER, 226 E. Main St., Chicopee Falls, Mass. This invention relates to window locks; its general purpose is to provide a device which will lock a window in closed position or in any one of several open positions so as to secure ventilation at the top or bottom of the window or both. It is also a purpose to provide a lock when in locking position prevents rattling of the window.

### Heating and Lighting

SAFETY GAS COCK.—B. J. DIEHL, Dry Harbor Road and Cooper Ave., Glendale, L. I., N. Y. The invention aims to provide a device wherein the accidental displacement of the conventional rubber tube from the end of



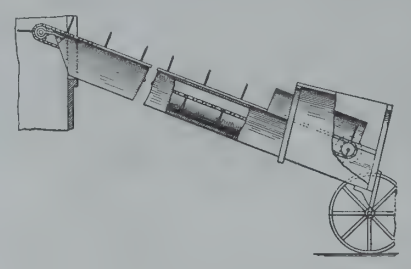
A SIDE VIEW PARTLY IN SECTION, OF A COCK WITH THE SECONDARY VALVE IN OPEN POSITION, AND MOUTHPIECE OF A RUBBER TUBE APPLIED

the gas-cock will result in the automatic shutting off of the flow of fluid. A further object is to provide a secondary valve for the nozzle in addition to the conventional turn valve, the secondary valve automatically cutting off the gas, should the tube be accidentally pulled off.

HEATED AIR SUPPLY APPARATUS FOR CLOTH DRIERS.—F. F. MCIVER, JR., Mandel McIver Co., 1805 1st Ave., New York, N. Y. Among the principal objects of the invention are, to avoid the necessity of providing a vertical support for cloth, to rest the supply of cloth in position for feeding the same to the drier, to prevent creasing the cloth while waiting to be dried, to economically heat air for supplying the drier and control the heater, and to avoid transmission of heat from the pipe supplying heated air to the casing thereof, forming a support for the cloth preliminary to drying.

### Machines and Mechanical Devices

GRAIN ELEVATOR.—J. B. MAJERUS, Bellechester, Minn. This patentee has produced a simple elevator of practical utility. It has running wheels at the rear and is adapted to be attached to any vehicle in transporting it from one place to another. When hauled to a barn or the like and positioned its trunk is inclined and the wheels removed for opera-



A SIDE ELEVATION, PARTS BEING BROKEN AWAY AND OTHERS IN SECTION

tion. The elevator is readily adapted to be given an angular position to suit the point of delivery. The grain is elevated by an endless belt with simple drive gear. A hopper is included into which the grain is shoveled or dumped.

APPARATUS FOR ICE MAKING AND REFRIGERATING PURPOSES.—C. DELAYGUE, address A. Monteilhet, 90 Blvd., Richard Lenoir, Paris, France. This invention relates to an apparatus for ice making, and mechanism is provided for evaporating in a closed vessel, by heat or other suitable means, a liquid in which are dissolved easily vaporizable substances, having a great affinity for the liquid, and in providing means for recovering and condensing the vapors in a second closed vessel constituting a refrigerator, and in finally producing in the said refrigerator the revaporization of the condensed products by contact with the substance to be cooled or frozen.

MACHINE OILER.—J. M. BUKACEK, Clarkson, Neb. This invention has for its object to provide an oiler adapted for use with machinery of any character, which may be made to positively deliver oil when desired, whatever the position of the oiler. The arrangement is such that when the handle is pressed toward the can a plunger is moved downwardly, thus forcing out the oil through the spout.

### Medical Devices

COMBINATION TRACTOR AND REPELLER.—P. C. JUHL, Princes Bay, S. I., N. Y. The invention relates to obstetrical instruments; its object is to provide a combination tractor and repeller more especially designed for use by veterinary surgeons on cows, horses, and other animals with a view to adjust abnormal position of a fetus. Another object is to enable a veterinary surgeon to readily apply and manipulate the instrument.

### Musical Devices

NEEDLE.—C. A. PORT, Windsor Mo. The invention has for its object to provide means for firmly holding a filament of wire against movement away from the record and for connecting the said filament to the needle holder of a talking machine in such manner that the wire may be used to engage the record.

### Prime Movers and Their Accessories

SUPERHEATER FOR INTERNAL COMBUSTION ENGINES.—H. A. LACERADA, 3258 Hudson Bldg., Jersey City, N. J. The object of the invention is to provide a superheater for internal combustion engines such as are used in automobiles, marine and aerial vessels and the like, and arranged to generate superheated steam and to supply the same to the explosive mixture to increase the efficiency thereof and prevent the formation of carbon and other deposits in the cylinder. Another object is to dispense with the usual overflow pipe in the radiator.

SPARK PLUG HOLDER.—C. E. WAKE, 509 E. Sumach St., Walla Walla, Wash. The invention has for its object to provide a device for conveniently handling spark plugs without danger or discomfort from the hot plugs, and without the necessity of soiling the hands. A further object is to provide a spark plug holder which grips the plug but which can be easily released therefrom by pressing the handle members toward each other.

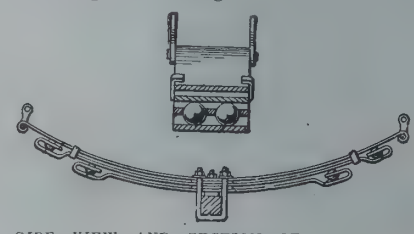
### Railways and Their Accessories

RAIL PLATE AND FASTENER. — J. G. HILL, 512 Railroad Exchange Bldg., Kansas City, Mo. The invention relates generally to track securing devices, and more particularly to a simple, economical rail plate and fastener, the object being the provision of an effective device which may be used in practice with great advantage, in order to prevent overturning and creeping of rails as well as an arrangement whereby the rails may be readily released and removed when substitution becomes necessary.

### Pertaining to Vehicles

TIRE FOR MOTOR VEHICLE.—J. J. DANA, 17 W. Anderson St., Savannah, Ga. The object of this invention is to provide a tire having the resiliency of a pneumatic tire, without the liability of the same to puncture and blowouts, and wherein the resiliency of the tire may be varied to suit conditions. The tire is characterized by a series of housing plates which permit of a limited hinge motion, and a tread ring of rubber or the like on its outer face.

BALL BEARING SPRING.—G. A. SAVILLE, JR., 619 So. 11th St., Lincoln, Neb. The invention has for its object to provide a spring especially adapted for motor vehicles, but suitable for vehicles of any character, wherein ball bearings are arranged between the leaves



A SIDE VIEW AND SECTION OF THE SPRING CONSTRUCTION

of the spring at the ends of the said leaves, a bearing being arranged at each end of the leaves between the said end and the adjacent leaf for making the spring more flexible, reducing wear and increasing resiliency.

LICENSE TAG HOLDER.—T. J. CHAPPELL, Castleton, N. D. This invention has for its object to provide a simple, inexpensive device of the character specified which may be detachably connected with the hood of a motor vehicle, and with the license tag in a manner to be easily removed when desired, and wherein the holder has means for preventing swinging of the crank.

VULCANIZER.—E. D. HOSTLER, Tipton, Iowa. The invention relates more particularly to a mandrel for use in vulcanizing the ends of the inner tubes for automobile tires and the like, an object being to provide a device which permits the tube ends to be vulcanized on the outside thereof, thus permitting a ready manipulation of the tube so as to insure a proper positioning of the parts and also permit a full observation of the vulcanizing process.

### Designs

DESIGN FOR AN INHALER.—E. H. METCALF, Marlboro, N. H.

DESIGN FOR A BRIDGE PLATE FOR WATCH MOVEMENTS.—C. F. COLOMB, 30 W. 36th St., New York, N. Y.

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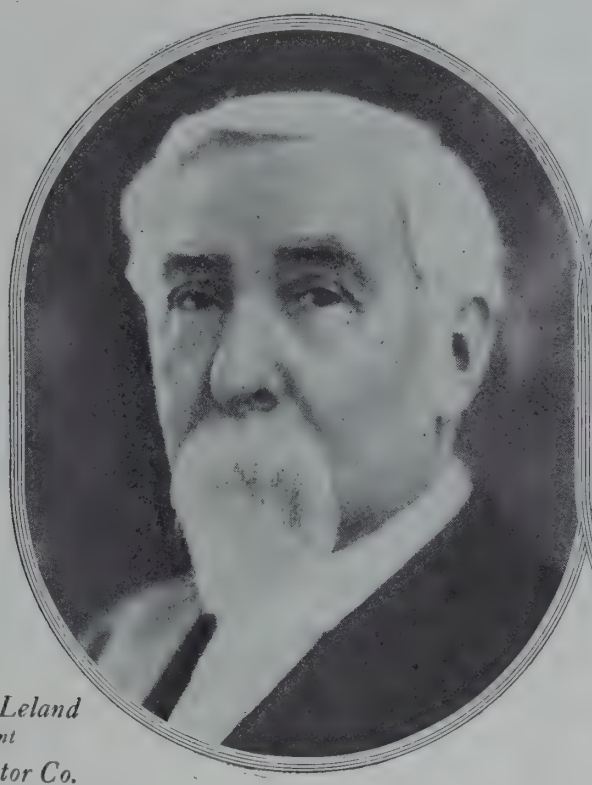
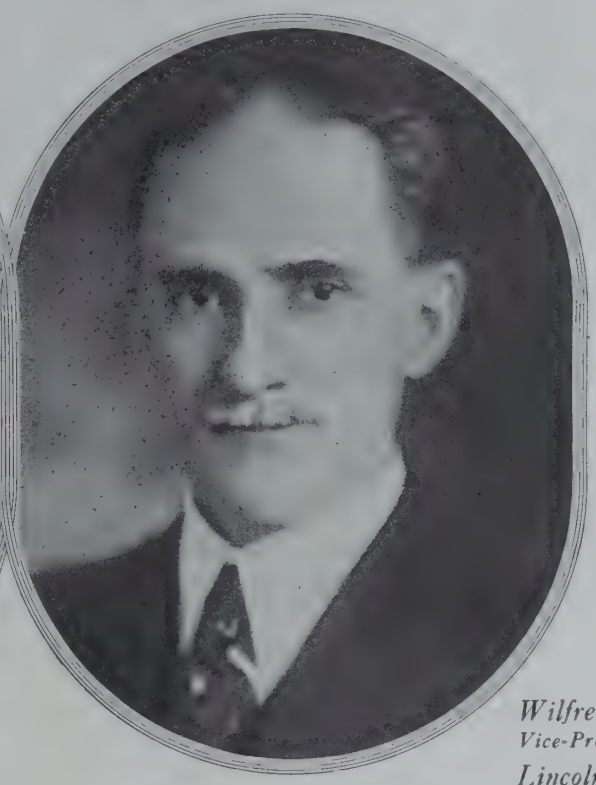
# The Leland Contributions to Motordom

*Pioneers of the Industry, Henry M. Leland and Wilfred C. Leland, Organizers of the Lincoln Motor Company have been outstanding factors in Motor Car Development*



*Henry M. Leland*
*President*
*Lincoln Motor Co.*



*Wilfred C. Leland*
*Vice-Pres. & Gen'l Mgr.*
*Lincoln Motor Co.*

Looking back over the progress of a generation, it would be difficult to recall anything which has contributed to the welfare of civilization and to the healthful enjoyment of mankind more than has the motor car.

Recalling the achievements which have marked the beginnings of various epoch-making periods in motordom, where do you find examples more impressive or which have been more far-reaching in their influence than those inaugurated by the Lelands during the past eighteen years, with the co-operation of thousands of skilled and loyal associates;

—the first practical, enduring car, made in large numbers;

—the thorough standardization and interchangeability of parts;

—close and fine workmanship, expressed by accuracy measured in thousandths of an inch and even in fractions of a thousandth;

—the initial adoption in motor car workmanship of the Johanssen gauges, accurate to the one-hundred-thousandth part of an inch—instruments which have helped to make possible such wonderful precision;

—scientific practices and methods in manufacture, which made possible a car of highest quality, at a price then far below prevailing figures for a comparable product:

—the electrical system of starting—lighting—ignition;

—the thermal regulation of the water circulating system;

—the V-type, *high-speed, high-efficiency* engine, the influence of which upon the industry has been almost immeasurable?

As a crowning achievement, one has but to observe their record both as to quantity and quality of Liberty aircraft motors.

And to the Lelands is due a multitude of other things—in manufacturing practices and in motor car refinement—some seeming small in themselves perhaps, but almost limitless in their influence and incalculable in their value in making motor cars the wonderful mechanisms they are today.

The Lelands have been favored by an additional advantage in that usually they have been afforded first opportunity to consider new devices developed by independent and unaffiliated genius.

This because it was realized that the seal of Leland approval spelled success in motordom, and that generally it meant ultimate adoption by other good-car makers.

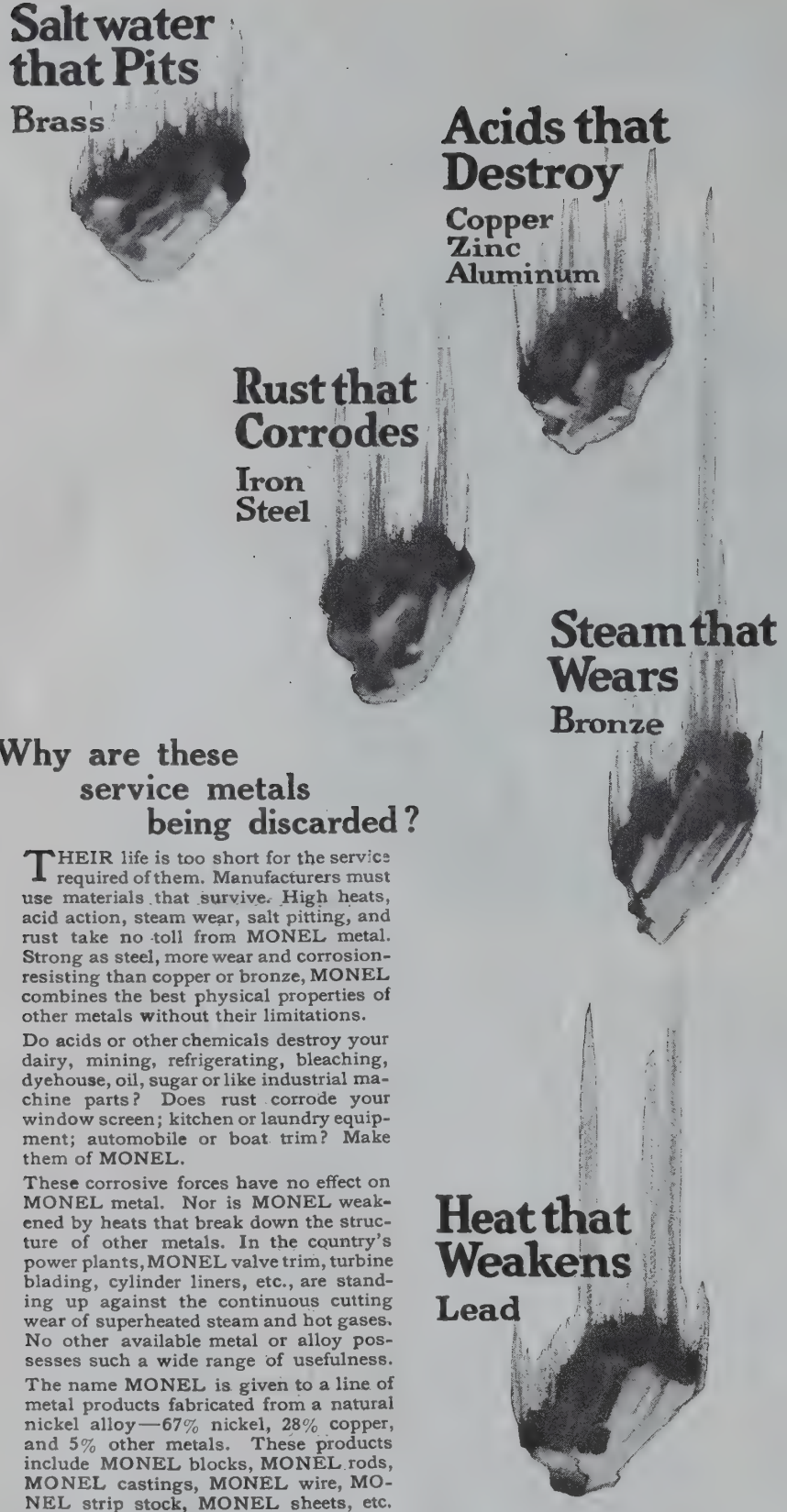
Entering the industry practically at its inception, the Lelands soon became recognized as possessing two predominant traits: first, to achieve and to surpass—for the sheer satisfaction derived from those accomplishments: second, to strive unceasingly for the betterment of motor cars, in everything that betterment signifies—to make them more trustworthy, to make them more enduring, to make them a source of greater comfort, to provide greater conveniences, to make their care and their operation unirksome—in short, to make their possession more desirable from every viewpoint.

Is it not logical, therefore, that men recognized as foremost exponents of advanced ideas, will guard and preserve that enviable distinction?

In the light of past accomplishments, could anything be more logical than that the new Leland-built car will embody refinements naturally to be expected of men occupying positions in the forefront of advancement—positions to which the serious-minded in the industry are wont to aspire?

And in the light of past accomplishments, could anything be more logical than that the new Leland-built car will uphold Leland traditions: and that it will evidence, more impressively than ever before, Leland determination and Leland ability to achieve—and to surpass?

LINCOLN MOTOR COMPANY DETROIT, MICHIGAN

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These corrosive forces have no effect on MONEL metal. Nor is MONEL weakened by heats that break down the structure of other metals. In the country's power plants, MONEL valve trim, turbine blading, cylinder liners, etc., are standing up against the continuous cutting wear of superheated steam and hot gases. No other available metal or alloy possesses such a wide range of usefulness.

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## Turning the Wheels of a Century Hence—III

(*Continued from page 60*)

horse-power. We want to use it. We want to keep it for our own, but to have it developed for us by individuals or corporations which know how, and which, naturally, want to be paid for their knowledge. Let us, therefore, enact such legislation as will foster water-power development; let us repeal such legislation as interferes with it. Let us take the red tape off the water wheel and let it turn and let us do it now—now, when coal is expensive and transportation vital and prices high and inexpensive power badly needed.

To do this we need a water-power bill which will help develop water power with private capital; charge the government with a certain amount of water-power development; develop the power now running to waste in national forest and other government-owned or reserved lands; conserve the rights and interests of the nation; make available our power as a measure of national preparedness for war; make our power sites revert to the nation, no matter how developed or what private capital is interested, in a sufficient period of years; and provide for an accurate, elaborate and complete report upon the available water power, natural and undeveloped, the possibilities of power to be developed by storage, and a continuing census of power statistics which will be at all times available to interested capital and to the government.

To this end, every power user should interest himself in the bill now before Congress, and use whatever influence he possesses to its passage, and what is more important, its speedy passage. The water wheel is as old as civilization. The United States has untold wealth running to waste every second of the day in undeveloped power. The high cost of living is partly a high cost of labor and labor is but another word for power. That we, supposedly the most progressive of nations, should have a great power source but partly developed, when we might have millions of horse-power turning our wheels without depleting our already exploited coal and oil fuel, is an economic crime.

In the last analysis, governments do what the people under those governments demand. This government will develop or cause to be developed the water power nod wasted when, and not until the people of the United States demand it. That demand is voiced only by individuals and associations. It is voiced by letter, word of mouth, newspaper publicity and telegram. It can be made effective only when it is large in volume, and large volume of voice comes from individuals, of which number you, the reader of these pages, are presumably one.

Power affects us all. Power is the root of our civilization. Power makes us great, and as it is cheap and efficient so is the process of living inexpensive and happy. To waste human power is to waste life itself; to waste national power is to drain away a nation's life for nothing.

What will *you* do to conserve and develop the wasted power resources of your country?

## Fighting Waves with Compressed Air

(*Continued from page 61*)

there were more safe harbors. Under the protection of compressed air, piers can be erected and maintained in any location, no matter how exposed, and vessels can ride there and be unloaded, no matter what weather conditions prevail.

Nor are these all of the uses of such a protecting system. It can be used to build up beaches, or to make them safe for bathers, and furthermore it does not destroy the appearance of the beach or make it unsafe and unsightly, as groins do.


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But the greatest service of all, perhaps, is the protection that can be given to boats and workmen in exposed places. The erection of breakwaters, piers, lighthouses and dams may be continued steadily, no matter how the white caps may toss. Think what such a system as this would have meant to old Captain Smeaton as he battled to make a lighthouse stand through the stress and storm on the wave-washed rocks at the entrance to Plymouth harbor. With the compressed air machinery working steadily, ample protection is given the builders.

### What About Our Forests?

(*Continued from page 62*)

the New England states is still forest land, in spite of heavy cutting and dense population. But careless woodsmen have done almost irreparable damage there. A recent scientific investigation revealed the fact that about half of all the fir in this territory, as well as in eastern Canada, is dead or dying, from insect pests and disease.

The reason assigned for this is that when wood was plentiful the woodsman scorned the fir tree, or balsam as it is called in Canada. The firs were left standing and other trees cut out around them. For a while the firs grew luxuriantly in their isolation but through this very fact has come their downfall. Insects and diseases to which the fir is peculiarly subject spread rapidly because there were no other trees to halt them and the result is that nearly all of this valuable lumber will be lost.

A relative of this tree, the Douglas fir of the West, now is one of our principal sources of lumber supply. The yearly harvest in the state of Washington alone now is about 6,000,000,000 board feet and in Oregon another 1,500,000,000 feet.

There are still large forests in the East outside of New England. State Forester Gaskill of New Jersey recently pointed out that there are 2,000,000 acres of woodland in his state and that the possibilities in these are now almost wholly neglected. New Jersey, he says, has a favorable climate for the growing of trees, much land unfit or ill fitted for agriculture, and close at hand markets for all the lumber that can be produced. Even on the so-called pine barrens in the southeastern part of the state, the growth of trees is rapid. Trees need little more care than protection from fire; and fires, even in New Jersey, rival the lumberman in destructiveness.

Some few states have already adopted forest policies but at present we are planting only one tree for every 10,000 that are cut down. There is nothing mysterious in successful forestry. Most European countries have followed the practise for many years of planting a tree for every one cut down. Only mature trees are allowed to be cut so that the forests are perpetual. It is true that much lumber is imported from this country but our own supplies have reached the point where we can continue our wasteful methods only at the greatest peril to the nation's future.

Europe's methods of reforesting are perhaps too costly for immediate adoption here but adoption of a real national program would undoubtedly bring the country's production of timber up to our needs and would prevent needless waste.

For instance it has been found that the best policy in the Douglas fir lands of the Northwest is to cut off the timber clean, perhaps leaving an occasional seeding tree. Then at the right season the land is burned over to destroy pests. This treatment results in a good stand of young trees and thereafter they need only protection from fire to produce 1,259 board feet of timber per acre each year while the trees are maturing. This involves very little expense and labor, aside from supervision and fire protection, and provides a paying crop on land which might otherwise have become a barren waste.

"They're good blades, those Starrett blades. Every tooth in 'em is made to cut fast and long."

Starrett Hack Saws ARE good hack saws. They've got to be to live up to the reputation of Starrett Tools. But speaking of teeth—how many of the teeth in the saws you're using now, no matter whose make it is, are cutting?

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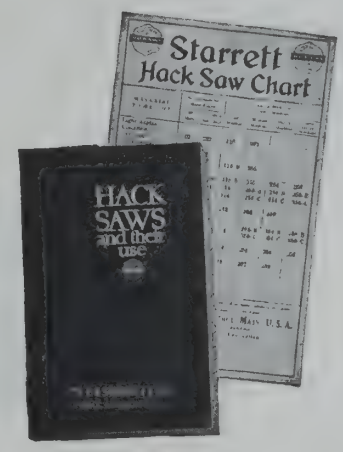
Both are free. Ask for Chart "B."

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Use Starrett Hack Saws


### Hack Saws and Lubricants

The unseen element in a hack saw blade is the quality given to it by heat treatment and quenching. Heat treatment may ruin the best of steel or it may, when properly done, give to each blade the exact quality that best suits it for the conditions under which it is to be used. Naturally the "temper" of a hack saw must vary with the material to be cut. No matter what temper the blade may have, however, it is an element that must be taken into account. Drawing the temper of a hack saw, by cutting without the use of lubricant, is a frequent cause of the failure of blades.

In this connection, the following excerpt from HACK SAWS AND THEIR USE, a new book just issued by The L. S. Starrett Company, is of interest to hack saw users:

"Compound should always be used except when cutting iron castings, as it greatly increases the output, doubling it at least. Either water or compound may be used, but never oil.

"Whatever the liquid employed, its purpose is not so much to lubricate the work as to cool the blade, since the high speed of cutting generates considerable heat which draws its temper. The work should be kept flooded, for a scanty flow of compound simply increases the likelihood of chips sticking in the cut and breaking the saw.

"The importance of lubrication, in its effect on the time per cut and the number of cuts per blade, is clearly shown in a test made with three identical saws, used on the same bar of metal.

"A flexible hack saw was chosen because, in the test, the abuse of the blade was intentional in the first two instances, and had an all-hard saw been selected, the probabilities are that it would have failed even sooner, especially as the strokes per minute, when cutting dry, were excessive.

"All these blades were started under the same pressure of 24 pounds. No. 1 saw was run without lubrication at 65 strokes per minute, an excess of 15 strokes over the recommended speed, and failed when partly through the fifth cut. Blade No. 2 was run 'dry' at 100 strokes per minute, or double the proper speed, and failed when about half way through the third cut. No. 3, *used with compound* at 100 strokes per minute, completed 50 cuts at a fair average speed, and was cutting at its apparent maximum efficiency under 56 pounds of pressure, when the test was discontinued.

"Just to what extent the excessive speed employed with the blades that were run 'dry' contributed to their early failure is a trifle uncertain, but its influence is none the less unmistakable. It may be said in this connection that, when cutting dry, an excess speed of as little as ten strokes per minute will ruin a saw by drawing its temper."

From HACK SAWS AND THEIR USE, published by The L. S. Starrett Company, Athol, Mass., for free distribution.

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If immediate steps are taken to care for these mighty forests of the Northwest the nation will be insured a continual lumber supply. If we continue our present course it will be only a matter of a few years when these forests will be in the position now occupied by the southern yellow pine forests. It is estimated these southern forests will be gone in ten years and that within seven years 3,000 manufacturing plants in the South will be forced out of business because of this fact.

To quote from a bulletin of the American Forestry Association:

"Within fifty years our present timber shortage will have become a blighting timber famine.

"Forests can be protected from fire, regrowth can be encouraged, conservative cutting can be practised, restoration can be accomplished—but it takes from fifty to a hundred years to mature a timber crop.

"Forest devastation must be stopped, lands now in forest must be kept continuously productive, forest lands now devastated and idle must be put to work."

It is a timely warning. The man who wishes to help need not go to the Northwest to do it. There are woodlands and trees in every community that need to be recognized as a valuable asset and given protection accordingly.

### "Resolute" Defends the Cup

(*Continued from page 64*)

that "Resolute" makes 9.25 knots over the actual distance sailed to windward, and 11 knots to leeward and that "Shamrock" saves 4 minutes of her handicap up the wind and two minutes down wind. To do this she would have to make about 9.6 knots to windward and 11.3 knots to leeward.

The assumed speeds are high, especially to windward; but they will serve the purpose of showing the task which "Shamrock IV" will have to perform if she is to save six minutes over the fastest boat for her length that we have ever turned out on this side of the water.

"Shamrock" has an excess of 20 per cent of sail area; but she labors under the disadvantage of a great excess of wetted surface. Moreover, the American boat has an easier form to drive, especially in reaching and running. On the other hand, looking at the problem broadly, the average yachtsman will tell you that as between sail area and time, he would choose the sail area.

### The Man Behind Our Daily Bread

(*Continued from page 66*)

weighing buckets and quickly returned to the bags after passing inspection.

The scales used in weighing are of the balance type. The grain is poured from the testing pan into a stationary funnel which is closed at the small end with a slide. When this slide is opened the grain pours down into a brass bucket which has a capacity of an even quart when leveled off. The bucket of grain is then attached to the scales, the reading bar of which has arbitrary figures showing what the grain will weigh a measured bushel. The inspectors must ascertain the weight of a measured bushel of grain inspected by them and report the same in their records, because weight is an important factor in arriving at a final decision on the quality of the grain.

After the grain is weighed it is carefully examined to determine its grade, and the inspector marks on a card with a printed form the grade number and kind of grain with notations and weights. This card is enclosed in the bag with the grain, and the clerical force makes a detailed record which is kept on file so that if a shipper at any time requires an inspection certificate it is issued upon request. The clerical department issues two certificates on every car inspected, which go to the receiver of the grain in Chicago, and he, in turn, sends one to the shipper and one to the buyer of the grain.


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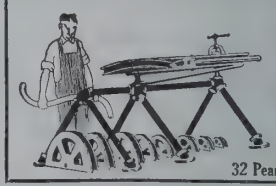

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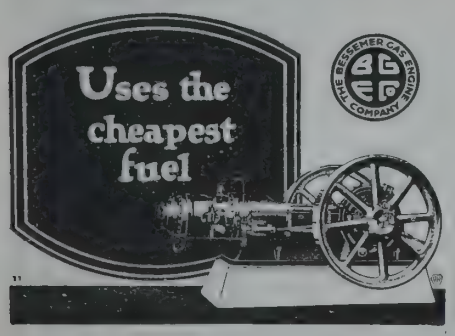


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14 York Street Grove City, Pa.

# BESSEMER OIL ENGINES


These certificates are issued on the day of inspection for the convenience of the trade in general. Half of the actual sample of grain inspected is retained in the offices of the Inspection Department and half is placed in a paper bag and sent to the grain commission merchant to whom the grain was consigned. The commission man uses this for his selling sample on the exchange floor of the Board of Trade.

In addition to the tests given other grain, corn is put through the moisture-tester. This method was not universally employed until in recent years, and its importance was augmented by the standard system of grading corn authorized by the government a few years ago. The amount of moisture contained in corn is a matter of great concern to the man handling it, and grain which in all other respects appears excellent has to be graded low when it is filled with water.

Corn containing much moisture does not keep as well as when dry, as it is apt to heat, sour or mold. Elevator people do not like to store it for this reason, and in warm weather it can be shipped only at considerable risk. The various industries engaged in the manufacture of corn products also prefer dry corn for economical reasons. The weather at the time the corn is harvested is a big factor in determining the amount of moisture it will contain, but corn absorbs moisture so readily that care must be used in handling it at all times.

The apparatus used for determining the amount of moisture in corn is simple enough in its operation yet truly wonderful in its achievement. Its principle is to boil the water out of the corn and condense it. This is accomplished by placing the corn in a glass container or distillation flask with a certain amount of mineral engine oil. These flasks are globular in shape with a neck at the top and a long narrow glass tube running from near the bottom of the neck. The flasks have a capacity of approximately 1,000 cubic centimeters, and are of the best grade of resistant glass and well annealed in order to withstand sudden changes in temperature without breaking.

After the bulk sample is properly mixed, the desired quantity for the moisture test is carefully weighed and emptied into the distillation flask with the necessary quantity of oil. In the case of corn, 100 grams by weight of the grain is used to 150 cubic centimeters of oil; with oats, 50 grams by weight to 150 cubic centimeters of oil. As soon as the grain and oil are placed in the distillation flask they are thoroughly mixed by shaking them. A thermometer, with rubber stopper attached, is then placed in the neck of the flask and the grain and oil heated to a temperature of 190 degrees Centigrade, after which the flame is turned off and the mixture allowed to cool about twenty-five degrees. The moisture in the grain turns to steam during this process and the only means of escape for the steam is through the tube of the flask. This tube is connected by a rubber stopper and runs through a tank of cold water. Thus the steam from the grain is condensed as it passes through the cold water and drops into a graduate below. The reading of this graduate when the grain has cooled completes the test.

Corn that shows only 14 per cent moisture is graded No. 1. If it contains 15.5 per cent it is graded No. 2; if 17.5 per cent, No. 3; if 19.5 per cent, No. 4; if 21.5 per cent, No. 5; and if 23 per cent, No. 6. Should the moisture content exceed 23 per cent it is classed "sample grade." About half an hour is required to determine the moisture content in each sample.

In determining the grade of corn there are other things besides the moisture test to be taken into consideration. These are damaged kernels; foreign matter; corn that is hot, heat-damaged, fire-burnt, sour, musty, immature, blistered, or infested

# You and yours

## Should brush teeth in this new way

*All statements approved by high dental authorities*

Millions of teeth are now cleaned in a new way. You see them everywhere—glistening teeth.

They are pretty teeth, but there's a deeper reason for them. They are safer, cleaner. The cloudy and destructive film is every day combated.

You will use this method and have your family use it when you make this ten-day test.

### To end the film

The purpose is to fight film—that viscous film you feel. It is the teeth's chief enemy.

It is that film-coat which discolors. Film is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Thus most tooth troubles are now traced to film.

The film is clinging. It enters crevices and stays. The ordinary tooth paste does not dissolve it, so the tooth brush leaves much of it intact.

It dims the teeth, and month after month, between dental cleanings, it may do a ceaseless damage. That is why tooth troubles come despite the daily brushing.

### What dentists urge

Dental science, after years of searching, has found a way to combat film. Authorities have amply proved it by many careful tests.

It is now embodied in a dentifrice called Pepsodent—a scientific tooth paste. And leading dentists everywhere are urging its daily use.

## Sent to anyone who asks

A 10-Day Tube of Pepsodent is sent to anyone who asks, and millions have thus proved it. Every person owes himself that test.

Pepsodent is based on pepsin, the digestant of albumin. The film is albuminous matter. The object of Pepsodent is to dissolve it, then to day by day combat it.

But pepsin must be activated, and the usual agent is an acid harmful to the teeth. So this method long seemed barred. Now science has discovered a harmless activating method, and active pepsin can be every day applied.

Two other problems have been solved in Pepsodent. In three ways this tooth paste brings a new era in teeth cleaning.

Watch the results of a ten-day test. Read the reason for them, then judge for yourself what is best.

**Pepsodent** PAT. OFF. REG. U. S.

*The new-day dentifrice*

**A scientific film combatant, combined with two other newly recognized essentials. Now advised by leading dentists everywhere and supplied by druggists in large tubes.**

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with live weevil. "White corn" must be at least 98 per cent white, and "yellow corn" at least 95 per cent yellow. The grades of wheat are determined by the variety, winter or spring (which mean, respectively, wheat sown in the fall and spring), hard or soft, and by soundness, plumpness, dryness, sweetness, weight, and also its degree of cleanliness. Color likewise is an important factor in grading wheat. Rules for grading oats, rye and barley are largely the same as those applied to wheat.

## Preventing the Oxidation of Metals from Heat

THERE are numerous places in which the ordinary means of preventing metal from oxidizing are futile. The leading electrical manufacturers, for instance, have long recognized the need for better protection of the various heating elements from this type of destruction; for in some cases these elements are exposed to oxygen in the unusually active form of ozone, created by the electric current itself, and even when his complication is absent, the extreme temperatures to which heating elements may be raised must necessarily make the oxidation problem an acute one. Another instance of similar exposure is found in mechanical soot-blowers for boilers, which are subjected to hard and continuous service at boiler temperatures, in the presence of hot gases of all sorts, and under the additional stress of mechanical contact with quantities of soot. And these are but examples showing that the ordinary resistant metals are not always sufficiently resistant to oxidation under acute conditions.

Several years ago one of the large electric companies, in view of this state of affairs, instituted a research for the development of some process of treatment that would render metals more resistant to oxidation at high temperatures. At the present time the process has reached a stage where this company is using it regularly; it has been tried out in several other connections, notably that of soot-blowers already mentioned; and it seems so promising that a company has been formed for the sole purpose of commercializing it.

The process, to which the name "calorizing" has been applied, depends upon the high heat-resistance of aluminum oxide. The parts to be treated are packed in a retort with an alumina mixture and other chemicals whose identity is not for the present divulged; hydrogen gas is introduced into the retort; and the temperature is then brought gradually up to 1650 degrees Fahrenheit in the electric furnace. After holding the heat at this point for a proper time, the retort is allowed to cool slowly, the introduction of the hydrogen still continuing. When cold the treated parts are withdrawn and cleaned. It is then found that the alumina has penetrated the surface metal of the treated parts to a greater or less degree, depending upon the time through which the process is allowed to extend. A homogeneous protective alloy is thus formed with the surface metal, not unlike an amalgam. This alloy shell is strongly resistant to the oxidizing influence of heat, and at the same time no physical change is apparent in the calorized portion of the metal, with the exception of the mild anneal resulting from the heating in the furnace. In particular, there is not the slightest tendency of the protective shell to strip or otherwise to behave as anything other than an integral part with the metal beneath it.

Over $100,000 has bee nexpended in developing the proper character of furnaces, retorts, mixtures and handling, and the development of the calorizing process has been brought to a high point of efficient application. During the past two years thousands of parts have been calorized for many of the largest industries of the country and the plant has been visited by many eminent chemists and metallurgists, as well as by mechanical experts, who were interested in observing the process in operation and determining the results by first hand investigation. Their reports have been enthusiastic and they generally predicted a large use for calorizing among industries experiencing heat-oxidation problems.

Where high temperatures in combustion are employed, ranging up to 1800 degrees Fahrenheit, calorized metal is said to give most excellent results. The ideal temperatures for its use range from 1100 to 1750 degrees Fahrenheit, and at 1800 degrees the resistance to oxidation from heat very sliwly diminishes. Close-grained cast iron, black and wrought iron, steel, nickel, nickel-steel, brass, bronze and copper have been successfully calorized and a much longer life incorporated in their use in high temperatures. A large application is seen in relation to calorizing of annealing and carbonizing boxes, pyrometer protection-tubes, retorts, super-heaters, vaporizers, burner collars, pipe and tubing, and a multitude of other uses among many industries. Calorizing is not a preventive of atmospheric oxidation, or oxidation from moisture. It has wonderful resistance, however, to oxidation from heat, up to 1800 degrees Fahrenheit, and assures a much less frequent replacing of equipment or machine parts, with elimination of the considerable labor cost involved and loss of production resulting from laying-up of equipment.

## Ball Bearings in Steamship Engines

THE Swedish ball bearing manufacturers, after introducing successfully ball bearings in Swedish rolling stock, especially the Swedish State railways, are now entering new fields of experimentation, which have for their object the introduction of the ball-bearing principle in ship construction, especially in connection with propeller shafting. The problem completes the construction of a bearing able to withstand all axial pressure from the propeller and excluding all possibilities of hot box and kindred troubles. The successful ball bearing, it is claimed, must under the most trying conditions be able to withstand the axial pressure automatically and require little or no attentio hand must be of such simple and reliable construction that friction within the same is minimal and that the ship's movements may not influence disadvantageously the ball-bearing mechanism.

While ball bearings are used to a considerable extent in marine engineering, their application and their mounting have seen their highest development in Swedish shipyards. This is the contention of Swedish shipbuilders generally, but will doubtless meet challenge in the United States and Great Britain, where shipbuilding yards have not been slow to see the advantages offered by ball bearing.

## Invention in Flashlight Photography

IN the *Times'* report of a meeting at the Royal College of Science, a demonstration in flashlight photography was given by Mr. K. Hickman. A "snap" of the audience was taken and a photograph of the chairman. The plates were then given a rapid development, with a lightning wash; fixation in afixing solution which was effective in 30 seconds, an invention of the lecturer; a further washing for 2 minutes, in which time the hypo was removed by dilute permanganate; a bath for 2 minutes in formalin solution, after which the plate was rinsed, dried in a stream of hot air from a machine of the lecturer's design, and finally printed on a lantern plate. Within half an hour of the exposure, a lantern-slide photograph of the chairman was projected onto the screen. Mr. Hickman also dealt with the screen-plate method of color photography which, he said, by its simplicity and the beauty of its productions, had ousted all other methods for amateur work.

engineering

IN THIS ISSUE:

LUBRICATING THE WORLD
DESCENDANTS OF THE WATER-WHEEL

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SHAPING A MODEL SHIP BY MEANS OF THE MODEL CUTTING MACHINE.—[See page 90]

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# "Say Pop, when are you going to get through?"

## *How the correct grade of Gargoyle Mobiloils cuts down Sunday morning tinkering*

SUNDAY morning, clear and cool; the week-end guests on hand; and the open road beckoning—

And then the endless Sunday morning tinkering while the family and guests walk impatiently up and down the lawn. *"When are you going to get through?"*

If you have to clean your spark plugs at frequent intervals, the chances are that you are using lubricating oil of incorrect body or low quality *"When are you going to get through?"*

If the compression is weak and your engine seems to lack power, it is probably because your oil tails to properly seal the piston rings. Results:—weak compression, loss of power, and dilution of lubricating oil. *"When are you going to get through?"*

The loss of power and irregular action may be due to sticky valves. Sticky valves usually result from the use of the wrong oil. *"When are you going to get through?"*

REPAIR SHOP RECORDS show that about 50% of all engine troubles are caused by incorrect lubrication.

These troubles are by no means confined to the three mentioned above. Other troubles commonly caused by incorrect lubrication are—piston-rings badly gummed or stuck in their recesses, smoky exhaust, worn wrist-pin or crank shaft bearings, scored cylinder walls, engine overheated, carbon deposit and pre-ignition.

The motorist who uses the grade of Gargoyle Mobiloils specified for his car enlists *scientific lubrication* on his side and cuts down Sunday morning tinkering.

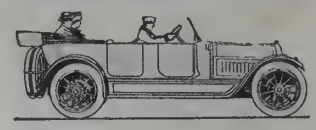
*"When are you going to get through?"*

GARGOYLE

# Mobiloils

*A grade for each type of Motor*

Domestic Branches: New York, Philadelphia, Pittsburgh, Indianapolis, Des Moines, Boston, Chicago, Detroit, Minneapolis, Kansas City, Kan.



## *Correct*
## AUTOMOBILE LUBRICATION

GARGOYLE

# Mobiloils

*A grade for each type of motor*

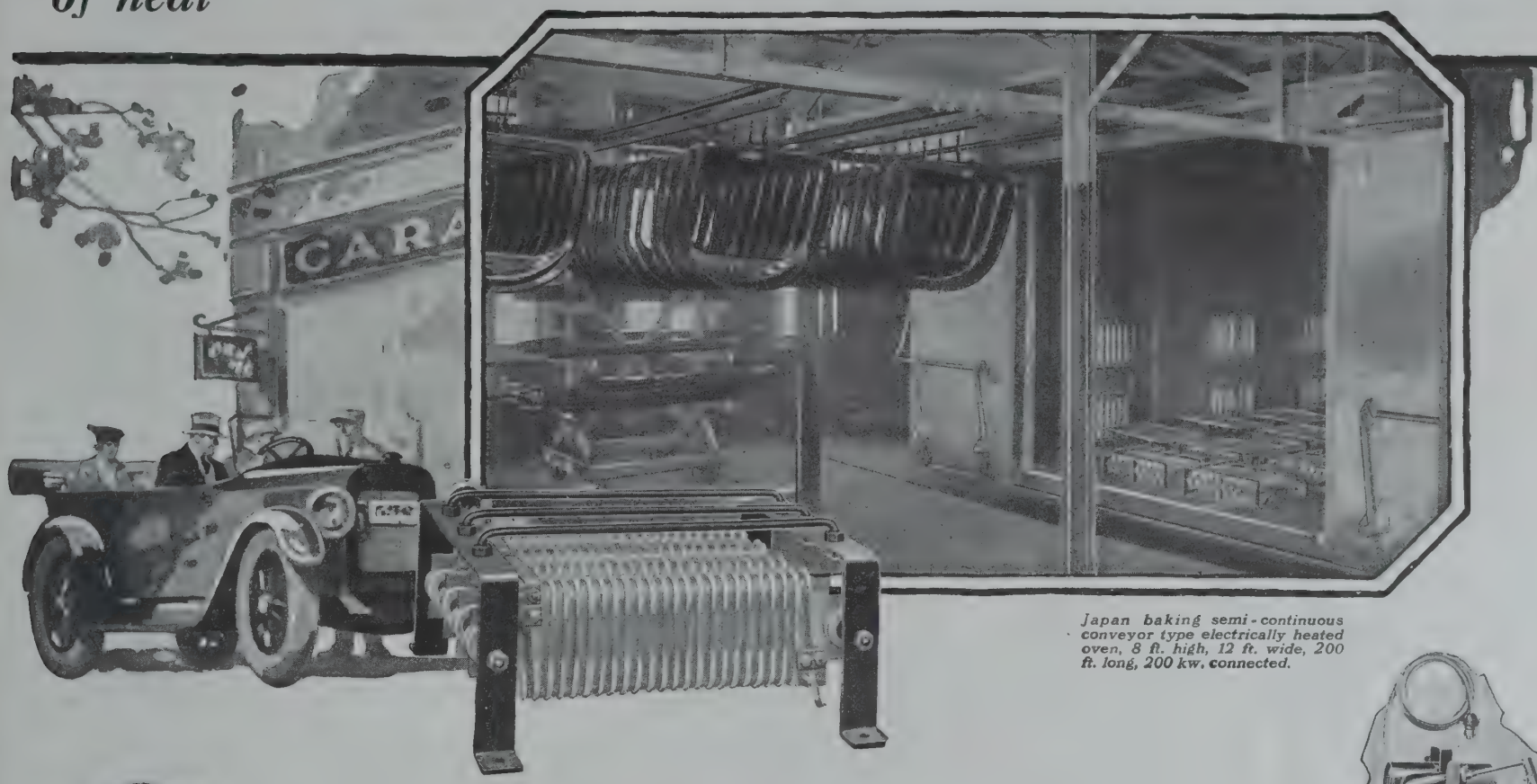
**Gargoyle Mobiloils for engine lubrication are:**

**Gargoyle Mobiloil "A"**
**Gargoyle Mobiloil "B"**
**Gargoyle Mobiloil "BB"**
**Gargoyle Mobiloil Arctic**

The Chart below indicates the grade recommended by the Vacuum Oil Company's Board of Engineers. The recommendations cover all models of both passenger and commercial vehicles unless otherwise noted. If your car is not listed in this partial Chart, send for booklet "Correct Lubrication" which lists the correct grades for *all* cars.

| AUTOMOBILES | 1919 Models | | 1918 Models | | 1917 Models | | 1916 Models | | 1915 Models | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| Allen | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Auburn (4 cyl.) | | | | | | | A | Arc | A | Arc |
| Auburn (6 cyl.) | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Auburn (6-38) | | | | | A | Arc | A | Arc | | |
| " (6-39B) (Teetor-H) | | | A | Arc | | | | | | |
| Autocar (2 cyl.) | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Briscoe | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| " (8 cyl.) | | | | | | | A | A | | |
| Buick | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Cadillac (8 cyl.) | A | A | A | A | A | A | A | A | Arc | Arc |
| Case | Arc | Arc | Arc | Arc | A | Arc | A | Arc | A | Arc |
| Chalmers | | | A | A | | | Arc | Arc | Arc | Arc |
| " (6-40) | | | | | | | A | Arc | | |
| " (6-30) | A | A | | | A | A | A | A | | |
| Chandler Six | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Chevrolet | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (8 cyl.) | A | A | A | A | A | A | | | | |
| " (F.A.) | A | Arc | A | Arc | | | | | | |
| Cole | | | | | | | Arc | Arc | Arc | Arc |
| " (8 cyl.) | A | A | A | A | A | A | A | A | A | A |
| Cunningham | | | | | | | | | Arc | Arc |
| " (8 cyl.) | A | A | A | A | A | A | A | A | | |
| Dart | Arc | Arc | A | Arc | A | Arc | A | Arc | Arc | Arc |
| " (Model C) | | | | | A | Arc | A | Arc | A | Arc |
| " (2 and 3½ ton) | A | A | A | A | | | | | | |
| Dodge Brothers | A | Arc | A | Arc | A | Arc | A | Arc | E | E |
| Dort | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Federal | Arc | Arc | A | A | Arc | Arc | Arc | Arc | Arc | Arc |
| " (Mod. S-X) | | | A | A | A | A | | | | |
| Federal (special) | | | Arc | Arc | | | | | | |
| Fiat | | | B | A | B | A | B | A | B | A |
| Ford | E | E | E | A | E | A | E | A | E | E |
| Franklin | A | A | A | A | A | A | A | A | A | A |
| Grant | A | Arc | A | Arc | A | Arc | A | Arc | Arc | Arc |
| " Com'l. | Arc | Arc | | | | | | | | |
| " " (Model 12) | A | Arc | | | | | | | | |
| Haynes | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| " (12 cyl.) | A | A | A | A | A | A | A | A | | |
| Hudson | | | | | | | Arc | Arc | Arc | Arc |
| " " Super Six | A | Arc | A | Arc | A | Arc | A | A | | |
| Hupmobile | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Kelly Springfield | A | A | A | A | A | A | A | A | A | A |
| King | | | | | | | | | A | Arc |
| " (8 cyl.) | A | A | A | A | A | A | A | A | Arc | Arc |
| " Commercial | | | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Kissel Kar | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| " " (Model 48) | | | | | | | A | A | A | A |
| " " (12 cyl.) | | | A | A | A | A | | | | |
| Lexington | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Lippard Stewart | | | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " " (Mod. M) | | | | | A | Arc | A | Arc | | |
| " " (Mod. MW) | | | | | A | Arc | | | | |
| Locomobile | A | E | A | E | E | E | E | E | E | E |
| McFarlan | | | A | Arc | A | Arc | A | A | A | Arc |
| McLaughlin | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| McLaughlin (Mod. E63) | A | A | A | A | | | | | | |
| Madison | | | A | Arc | A | Arc | A | Arc | A | Arc |
| " (8 cyl.) | | | | | A | A | A | A | | |
| Marmon | A | A | A | A | A | A | A | A | A | Arc |
| Maxwell | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Mercer | A | A | A | A | A | A | A | A | A | Arc |
| " (22-70) | | | | | | | | | Arc | Arc |
| Mitchell | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| " (8 cyl.) | | | | | | | A | A | | |
| Moline-Knight | B | A | B | A | A | A | A | A | A | A |
| Monroe | | | A | Arc | A | Arc | E | E | A | Arc |
| " " (Mod. M4) | | | A | A | A | A | | | | |
| " (Mod. S) | A | A | | | | | | | | |
| Moon | | | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Nash | A | Arc | A | Arc | | | | | | |
| " (Mod. 671) | | | A | A | | | | | | |
| " (Quad) | A | A | A | A | | | | | | |
| National | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc | A | Arc |
| " (12 cyl.) | A | A | A | A | A | A | A | A | | |
| Nelson | A | A | A | A | A | A | | | | |
| Oakland | A | A | A | A | Arc | Arc | Arc | Arc | Arc | Arc |
| " (8 cyl.) | | | | | | | Arc | Arc | | |
| Oldsmobile (4 cyl.) | A | Arc | | | | | | | Arc | Arc |
| " (6 cyl.) | A | A | A | A | Arc | Arc | | | Arc | Arc |
| " (8 cyl.) | A | A | A | A | A | A | A | A | | |
| Overland | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Packard | | | | | | | | | A | Arc |
| " (12 cyl.) | A | A | A | A | A | A | A | A | | |
| " Commercial | A | A | A | A | A | A | A | A | A | A |
| Paige (4 cyl.) | | | | | | | | | A | Arc |
| " (6 cyl.) | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (6-36) | | | | | | | A | Arc | A | Arc |
| " (6-38-39) | | | | | A | Arc | | | | |
| " (6-40) | A | Arc | A | Arc | | | | | | |
| Paige (Com'l) | Arc | Arc | Arc | Arc | | | | | | |
| Paterson | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Peerless | | | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| (8 cyl.) | A | A | A | A | A | A | A | A | | |
| Pierce Arrow | A | A | A | A | A | A | A | A | Arc | Arc |
| " " Com'l. | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| Premier | A | A | A | A | A | A | A | Arc | A | Arc |
| Regal | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| (8 cyl.) | | | | | | | A | A | Arc | Arc |
| Renault (French) | | | | | | | A | Arc | A | Arc |
| Reo | A | Arc | A | Arc | A | Arc | A | A | A | Arc |
| Riker | A | E | A | E | E | E | | | | |
| Saxon | E | E | E | E | E | E | E | E | E | E |
| Selden | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (¾ ton) | | | | | A | Arc | | | | |
| Simplex Crane | | | A | A | A | A | A | Arc | Arc | Arc |
| Stearns-Knight | B | A | B | A | A | A | B | A | B | A |
| Studebaker | A | Arc | A | Arc | A | Arc | A | Arc | Arc | Arc |
| Stutz | A | A | A | A | A | A | A | A | A | A |
| Velie (4 cyl.) | | | | | | | | | A | Arc |
| " (6 cyl.) | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (2 & 3½ ton) | Arc | Arc | Arc | Arc | | | | | | |
| " (¾ ton) | A | Arc | A | Arc | | | | | | |
| Westcott | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| White | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |
| " (Sixteen Valve) | A | A | A | A | A | A | | | | |
| White (3 ton) | A | A | Arc | Arc | | | | | | |
| Willys-Knight | B | A | B | A | A | A | B | A | B | A |
| Willys Sut | Arc | Arc | Arc | Arc | Arc | Arc | | | | |
| Winton | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc |

*Five years ago electric heat was somewhat of a novelty—today it is doing what was then considered impossible with any kind of heat*



*Japan baking semi-continuous conveyor type electrically heated oven, 8 ft. high, 12 ft. wide, 200 ft. long, 200 kw. connected.*

*Compound melting pot*

*Electric soldering iron*

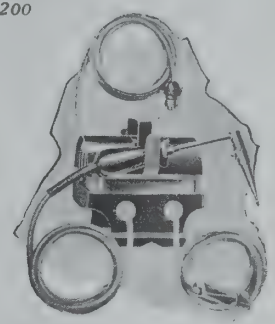
*Electrically heated glue pot*

## Beautiful Bodies Help Sell Motor Cars

ANY motor car builder will admit that a large number of cars is sold on "looks." As a result, the finishing of bodies and all enameled parts such as fenders, wheels, tanks, etc., is a process that requires most careful consideration and the best equipment available. In this process, the electric oven has come to the front through its obvious advantages over old-fashioned methods of baking. Its use greatly increases production, thereby reducing the unit cost, even with higher rates for power than for fuel. Electric heat produces a lustrous, hard finish so essential for lasting beauty, and it requires less time than other forms of heat, with more accurate control, greater safety, and practically no defective work that must be done a second time.

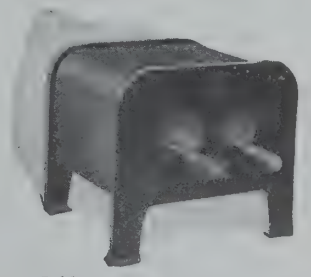
The flexibility of electric heat is remarkable since it permits the use of varying degrees of heat in different parts of the same oven or furnace. For this reason, electric heat is rapidly being applied to the baking of varnish, enamel, japan, and other finishes; to the melting of metals and alloys; to the heating of steel so that it may be chemically treated; to the drying of salts, sand cores, pottery and grinding wheels; to the heating of rivets, soldering irons, etc.; and even to the sherardizing of steel to make it rustproof by depositing on its surface a coating of zinc about twenty-five ten-thousandths of an inch thick.

To every one of the many uses of electric heat the General Electric Company has contributed in a broad way, until today the mark G-E on any electric heating device is the mark of the master. Thus it is to any manufacturer's advantage to consult G-E engineers before selecting such equipment.



*Pyrotip lead burner*

*Cartridge type electric heating unit*



*Soldering iron muffle furnace*

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

39-40

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# Working day and night

"After running 218 miles per day (24 hours), 7 days a week for 31 consecutive weeks, this 5½-ton Mack is now making daily round trips from New York to Philadelphia—piling up an almost unbelievable mileage record."—*From one letter of hundreds we should like you to read.*

AXLES of drop-forged chrome nickel steel, springs of heavy silico-manganese steel, and a flexible, hot riveted, pressed steel frame—these Mack details make capacity deliveries over long routes both practicable and profitable. Distinctive Mack engineering features, combined with 18 basic Mack patents, have developed the motor truck the world is talking about.

Capacities, 1½ to 7½ tons. Tractors to 15 tons
*Full information upon request*

INTERNATIONAL MOTOR COMPANY OF NEW YORK

Mack TRUCKS

"PERFORMANCE COUNTS"

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 4 ] NEW YORK, JULY 24, 1920 [ 15 CENTS A COPY 20 CENTS IN CANADA

**Bird's-eye view of Long Island looking toward New York City, showing the grounds, antennæ system and building of the New York Radio Central Station to be constructed**

## The Last Word in Wireless—The New York Radio Central Station

FOR more than two decades the wonders of wireless have so unceasingly intrigued the public imagination that it would appear little remained to be accomplished in developments of revolutionary character. Yet, once again, it is disclosed that a startling conception in wireless communication has been quietly brought to a point of realization. On the north shore of Long Island, near New York, a leading American radio company is about to begin construction of a super-powered radio station that will simultaneously send to and receive messages from five great nations of other continents.

The new and great medium of far-reaching economic and political influence will bear the name of *New York Radio Central Station*, the steel towers of which will rise on a 6,400-acre tract, comprising nearly ten square miles of land lying east of Port Jefferson, with a long frontage on Long Island Sound. The preliminary engineering studies have been completed, contracts for all the construction materials are being let, and a force of radio experts, after months of preparation, will immediately take the big job in hand.

A definite idea of the ultra-modern character of this radio plant may be gained from the observations of Edward J. Nally, president of the Radio Corporation of America (a combination of the General Electric Company and the former Marconi Company) under whose direction the world wide wireless system has emerged from an idea into a reality. "Everyone at all familiar with wireless," said Mr. Nally, "knows that at Nauen, Germany, and Bordeaux, France, are two of the largest stations in the world. Up to now they have been viewed with admiration; consider, then, the tremendous advance represented in this latest step: the New York Radio Central Station in the aggregate will be five times more powerful than either of these."

He explained that there will be five complete transmitters, each one a duplex unit with a corresponding receiving station located near by. All five transmitters and the five receivers will operate simultaneously and will transmit and receive messages over thousands of miles continuously day and night.

The form of aerial construction, too, is wholly a new departure. From the central power house six spans of aerial wire will radiate out in a star pattern to a distance of more than one mile from the center. The wires of this huge antenna will be supported on self-supporting steel towers, each 400 feet in height, with the wires suspended at the top between 150-foot cross arms. Each of the six antennæ will have twelve towers, forming so to speak the spokes of a giant wheel fashioned out of seventy-two miniature replicas of the famous Eiffel Tower in France. Five of these antennæ spokes will be used for regular service while the sixth is reserved for emergency operation.

Far more impressive than physical appearance, however, will be the things the eye cannot encompass. Appreciate, that in the wires forming each spoke of the gigantic wheel there will be generated a power equal to the greatest of present day transoceanic wireless stations; then comprehend, if you can, the fact that all five of these powers can, if desired, be combined into one, for signaling. A telegraphic signal created out of such tremendous electromagnetic energy could encircle the entire globe!

But that is not all. The apparatus and system which will be installed for each of the five units will be the same as that at present in our New Brunswick (N. J.) station from which the voice of Secretary of the Navy Daniels was carried to President Wilson when he was at sea aboard the U.S.S. "George Washington." In a number of experimental tests the voice has been carried by this radio telephone over distances of 2,500 miles with complete success. This leads us to state very definitely that before long a direct wireless telephone service will be established with foreign countries.

Every exacting requirement of commercial radio message service will be satisfied fully in the apparatus and system of circuits with which the great station will be equipped. The generation of the energy required to span thousands of miles will be effected by Alexanderson alternators, which have made it possible to carry the radio signals through space by continuous wave trains instead of by the interrupted or discontinuous waves generated by systems using the old-time "spark discharge" apparatus. In the Alexanderson alternator equipment the new station will have a source of energy proven as reliable as the power dynamo, yet creating a steady stream of electromagnetic oscillations, which will permit telegraphic signaling at very high speeds.

So efficient and reliable has the Alexanderson 200-kilowatt alternator installed at New Brunswick proven itself, that leading radio experts of Europe have made special trips of investigation to the United States to view its performance; now this already famous single

(*Continued on page 92*)

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## A Real Start in Aeronautics

WE cannot commend too highly the plans of the Post Office Department for establishing, in addition to its own transcontinental airplane service between New York and San Francisco, four other routes between leading cities of the country, which are to be operated by private contract. Congress has made an appropriation of over one million dollars for the service to be operated by the Post Office Department from New York City by way of Cleveland, Chicago and Omaha, to San Francisco. The first routes to be established by the Government will be those for which the Post Office Department is now asking bids, as follows:

Cleveland-Detroit, 95 miles by air; 1,000 pounds of mail per trip. Pittsburg-St. Louis, 600 miles; 1,500 pounds of mail. New York-Pittsburgh-Chicago, 735 miles; 1,500 pounds of mail. New-York-Atlanta, 815 miles; 1,500 pounds of mail. In each case one trip each way 306 days in the year, with leading intermediate stops (except, of course, between Cleveland and Detroit).

In drawing up the specifications the Post Office has been able to call upon its own extended experience during the two years' operation of its air mail service, and it states that any type of modern airplane can easily perform the service.

In a recent issue we quoted from a paper lately read by Colonel Vincent, in which he stated that the most practicable way for the Government to promote commercial aviation in the United States would be by the extension of its air mail service. This it is now about to do, and on a scale that will vigorously stimulate what threatened to become a moribund industry. To set up these five great routes and maintain them will call for a large and steady output of airplanes, and we have no doubt that the states and cities affected will come forward with generous assistance in providing the necessary sites for the many landing fields that must be provided.

If this great venture shall prove to be a success—and the Department would never have launched out so boldly unless its two years' experience gave good promise of success—we may look for an eventual revival of our airplane industry upon a steadily increasing scale.

## About That Einstein Prize

SOMEBODY has asked us what we hope to accomplish by the five-thousand-dollar prize competition which we announced two weeks ago. Our interrogator points out that for five to ten years the Einstein theories have been quite familiar to those mathematicians whose interest lay in the field which would draw their attention to this work. He calls our personal attention to the fact that as long ago as 1914 we were in the habit of dodging discussion with him of the mathematical aspects of relativity. He points out that since the incident of the eclipse several books on the subject have appeared, to say nothing of a quantity of magazine articles. His general viewpoint seems to be a doubt that anything can be done in a three-thousand-word essay which has not been done in one or several of these.

It is in the thought that this viewpoint may be somewhat general that we write these few words. We have not the slightest idea that the essay competition is going to bring out any new knowledge, that the winner or any of the other contestants will be able to say anything about the Einstein theories that is not already a matter of knowledge and of record. But that is not the point.

Of all these books, we should say that Dr. Eddington's is most nearly complete and possessed of greatest scientific value, and that Dr. Slosson's has the best appeal to the reader who is not versed in the devious ways of those mathematical fields that make the calculus look like the merest elements of the subject. But in both these books there are plenty of places that are pretty tough reading; we do not believe that anyone not a mathematician can read through either book conscentiously without getting lost more or less frequently.

An essay of three thousand words is not long enough to lose a reader more than once; if it does lose him it is a failure, and if it doesn't it is a competitor that will go into the final elimination trials for the prize. If we can present, as a result of the contest, six or a dozen essays of this length that will not lose the lay reader at all, we shall have produced something amply worth the expenditure of Mr. Higgins' money and our time. For such a number of essays of such character will of necessity present many different aspects of the Einstein theories, and in many different ways, and in doing so will contribute greatly to the popular enlightenment.

Really the significant part of what has already appeared is not the part that is intelligible, but rather the part that, being unintelligible, casts the shadow of doubt and suspicion on the whole. The successful competitor for the prize and his close contestants will have written essays that, without any claim to completeness, will emphasize what seems to each author the big outstanding feature; and every one of them will be intelligible. Together they will in all probability be reasonably complete, and will retain the individual characteristic of intelligibility. They will approach the various parts of the field from various directions—we could fill this page with suggestions as to how the one item of the four-dimensional character of Einstein's time-space might be set forth for the general reader. And when a man must say in three thousand words as much as he can of what eminent scientists have said in a whole volume—well, the result in some cases will be sheer failure, and in others a product of the first water. The best of the essays will shine through intelligent selection of what is to be said, and brilliant success in saying it. It is to get a group of essays of this character, not to get new knowledge of relativity, that the prize is offered.

## General Crozier on Our Ordnance Effort

NO phase of our preparation for the war attracted so much attention as the provision of ordnance for our rapidly forming armies. It is not generally known that ordnance constituted by far the largest single item of expense. The Bureau of Ordnance had on its books on the date of the armistice some fourteen billions of dollars of which, if we remember rightly, nearly one-half was expended. Naturally the citizen will ask: "Why were these enormous sums necessary? And why was it, with funds so lavishly provided, that we were so largely dependent upon our allies for field and heavy artillery, and, in less measure, at the outset of our field operations, for rifles and machine guns?" The answer to these questions is given in a very clear, precise and straightforward way by Major General William Crozier, Chief of the Bureau of Ordnance, now retired, in a book entitled "Ordnance and the World War." "Everybody now knows," says the author, "that we entered the war with a very small army and a totally inadequate supply of arms, ammunition and other equipment. But there are some who do not know why it took so long a time to raise the war army and transport it to Europe, or why its supply of certain American-made munitions was so long delayed."

The public, in a spirit of good sportsmanship, if we may put it that way, should welcome a work of this kind from any military man whose administration has been subjected to criticism; he is prevented, while in the service, from telling the simple facts which would set him right in the eyes of the nation. There is a world of meaning in the last clause of the introductory chapter in which the General says: "I should add that, having retired from active service, I am no longer a part of the War Department or of the Army with the Colors. I therefore speak without official authority, and with something of the freedom of any other citizen."

Naturally, the chapters dealing with machine guns will attract the most attention, this because of the long controversy which raged around the question of the delay in the adoption of the Lewis machine gun. General Crozier has adopted the wise course of giving a succinct statement of the various tests which were made by the War Department of the various types of machine guns, including the Lewis gun, offered to the Government, and the facts as thus presented will enable any civilian to judge for himself the merits of the case.

Because these weapons operate with tremendous pressure and enormous velocity of moving parts, the General tells us that "no entirely satisfactory machine gun has yet been developed, that is to say, we have never had a machine gun that is not subject to stoppage by reason of some kind of malfunction," although the Browning gun is a great advance in this respect. Speaking of the service rendered, he says that the Benet-Mercier gives out about one horse-power for each pound of its weight, which is approximately double the output per pound of the Liberty engine.

In 1913 the Ordnance Department arranged a competitive test of automatic machine rifles at which all of the seven competing guns were eliminated except the Benet-Mercier and the Vickers; and in the subsequent field test, in the spring of 1914, the Vickers gun was selected. The report stated that in the endurance test there were with the Lewis gun 206 jams and malfunctions; with the Vickers gun, 23; and with the Benet-Mercier, 59. The next test took place at the Springfield Armory in April, 1916, when the service gun was withdrawn by the makers on the ground that it was in an experimental stage. The War Department Board found that the Lewis gun, in its then stage of development, was not as reliable as the other guns tested, the number of jams and malfunctions of the Lewis gun being 314 as against 59 of the Springfield and 23 for the Vickers gun, the duration of the firing being respectively 123 minutes, 147 minutes and 84 minutes. "The Lewis gun," the report goes on to say, "is lighter, simpler, and has a fewer number of parts than the other guns mentioned." These results were borne out by experience had on the Mexican border in the same year. General Crozier quotes a report of the School of Musketry as saying, "The Lewis gun, while it is not a dependable weapon at present, is believed to possess great possibilities."

As a matter of fact the interests which had the Lewis gun in hand during this period were turning out a very much better weapon in Great Britain than they were in this country, and it was only a question of time when the Lewis gun would be found available for our own service. As General Crozier says, "It must be remembered that no Lewis gun, as made in England for the British service, had ever been available in the United States, even for test." He tells us that throughout the winter and in the early spring of 1917, over fifteen important changes had been made in the gun. That it had now been brought to a state of practicability for use with American ammunition was shown by a test held under the auspices of the Navy Department. Consequently, after our entrance into the war and as soon as funds were available, the Ordnance Department ordered 4,400 Lewis guns, and after a test by the War Department Machine-Gun Board in May, 1917, they reported that the Lewis machine gun, caliber .30, fully established its character as a first-class machine gun. Following this report, Lewis guns were ordered as funds became available.

When our plants had been established and were going at full pressure, the output of machine guns and automatic rifles of the Vickers, Lewis, Colt-Marlin and Browning types was 180,000 at the date of the armistice, and our rate of manufacture reached a point such as to remove all fear that our troops might lack a sufficient number of weapons of this class.

## Electricity

**Electric Shock Aid.**—The National Safety Council of Chicago, Ill., has issued a large wall bulletin suitable for putting on the walls of power houses and central-station buildings, giving the rules adopted by the National Electric Light Association for using the prone pressure method of resuscitation for electric shock. The bulletin is illustrated with three cuts showing the application of the treatment. The council has also issued pamphlet No. 29, entitled "Electrical Equipment in Industrial Plants," which, according to a subtitle, is "an orderly presentation in loose-leaf form of ancient hazards and the best practises for their elimination."

**VibrationGalvanometers** are useful in null measurements but have not been used in industrial laboratories because they are sensitive to external vibrations and require delicate adjustments. The present instrument, which has a sensitivity higher than other forms of the moving-iron type but less than that of the most sensitive forms of the moving-coil type, has the advantages of sturdiness, quick responsiveness and freedom from the effects of external vibration. It consists essentially of a fine steel wire mounted on one pole of a permanent magnet and so arranged that the free end of the wire may vibrate between the poles of an electromagnet through which the current to be detected passes.

**Cadmium-Vapor Arc Lamp.**—The Bureau of Standards, Washington, D. C., has announced, through Scientific Paper No. 371, the development of a new method of producing a cadmium vapor arc of great brilliancy. It was found that the metal gallium alloyed with cadmium, and since gallium has a boiling point above 1,500°C., the vapor-pressure relation which exists between cadmium and mercury is reversed when compared with cadmium and gallium. The cadmium therefore acts as the energy carrier when used in combination with gallium in a quartz lamp. The cadmium-vapor lamp may be operated with a current of three amperes and a drop of 14 volts across the terminals, but gives the best results when operated at about 25 volts. Under this condition a practically pure cadmium spectrum is obtained. The lamp is expected to fill a demand for a light source of this character.

**Resistance for Rheostats.**—Where resistances are formed of spirals of wire, the sections of the wires must be so determined that the cooling surface per unit of power is constant, depending on cooling conditions. In an article appearing in a French periodical, it is demonstrated mathematically how a saving of metal may be effected by using several wires in parallel instead of a single one. The volume and, consequently, the weight of wire used for the resistance, is the less the more wires in parallel are used; a resistance formed of a single wire weighs 3.3 times as much as the same resistance of six wires in parallel. Of course, the dimensions of the rheostat and the cost of labor increase with the number of wires, so that there is an economic number for each case. If the resistances are formed of bands of very thin wires, with which the section is proportional to current density, the weight of metal is constant whatever the number of conductors in parallel, so that it is usually best to take a single conductor.

**Double-Base Incandescent Lamp.**—A new double-base lamp by means of which household appliances and fixtures may be used simultaneously from the same outlet without the use of double plugs or adapters has been developed by E. O. Schweitzer, chief testing engineer of the Commonwealth Edison Company of Chicago. The lamp may be made up in any style and capacity. The lead-in wires are those used for the standard 500-watt lamp and continue through the bulb from base to base, the lamp filament being tapped off from them. The lead-in wires, which are formed into an expansion loop to eliminate strain due to unequal contraction and expansion of the lamp elements, are made with a quarter twist to provide clearance for the filament anchors. Exhaustion is carried out through a concealed tube within one of the bases, continues *Electrical World*, thus making a tipless lamp. By the addition of a light brass shell beaded at each end any standard shade holder may be used. The extra attachment to the lamp may be made by using a socket screwed to its free base.

## Science

**A Board of Surveys and Maps** has been created by executive order, for the purpose of coördinating the activities of the map-making agencies of the United States Government.

**A Notable Contribution to Palæobotany** is Dr. F. H. Knowlton's "Catalogue of the Mesozoic and Cenozoic Plants of North America," published as U. S. Geological Survey Bulletin 696. The work contains bibliographic references to about 735 genera and about 4150 named species and varieties of plants found in the Mesozoic and Cenozoic of the United States and Canada, and makes a ponderous volume. The bibliography contains 474 titles.

**The Leucoscope in Pyrometry.**—The Bureau of Standards has recently been making experiments with the leucoscope, an instrument devised many years ago by Helmholtz for light and color analysis, and finds that this instrument, originally used in the study of vision, has useful applications in pyrometry. New laws have been discovered, relating the readings of the instrument to temperature and spectral energy distribution in a light source or furnace. The results of this investigation have been communicated to the Optical Society of America, for publication in its journal.

**The American Geophysical Union.**—The American section of the International Geophysical Union, which met in Brussels in July, 1919, has recently been reorganized and enlarged to form the American Geophysical Union. It is divided into six sections, which, with their chairmen, are as follows: (a) Geodesy, William Bowie; (b) seismology, H. F. Reid; (c) meteorology, C. F. Marvin; (d) terrestrial magnetism and electricity, L. A. Bauer; (e) physical oceanography, G. W. Littlehales; (f) volcanology, H. S. Washington. The secretary of the Union is Prof. Harry O. Wood, of Johns Hopkins University.

**Improvements in Map Projections.**—The U. S. Coast and Geodetic Survey has been devoting much attention of late to the subject of map projections, and has issued several interesting memoirs relating to projections which have been little used in this country, together with specimen maps. The latest publication of this sort is a new outline base map of the United States on the Lambert zenithal equal-area projection, scale 1:7,500,000. This is the first map on this projection ever published by the Survey. Besides its useful property of equal area, the projection has smaller scale and direction errors than the polyconic projection map which has been so frequently used for political, census, and miscellaneous statistical purposes.

**The Federal Board of Surveys and Maps,** created by an executive order of December 30, 1919, is now fully organized, with representatives from 14 map-publishing branches of the Government. At the initial meeting of the Board, in January, officers were elected for 1920, viz., O. C. Merrill, Forest Service, chairman; William Bowie, Coast and Geodetic Survey, vice-chairman; C. H. Birdseye, Geological Survey, secretary. Committees have been appointed on topographic maps, highway maps, hydrographic maps, photographic surveying, and several other special subjects. A Map Information Office has been organized, with headquarters at the U. S. Geological Survey. The establishment of this office is an event of much public interest, as it provides a central agency in Washington from which information can be promptly obtained concerning all map and survey data available in the numerous Government offices which carry on cartographic work of any kind. The new Federal Board is charged with the duties of making recommendation to the several departments of the Government or to the President for the purpose of coördinating the map-making and surveying activities of the Government and of settling all questions at issue between the departments relating to such subjects, within the limitations of existing laws. The Board is also directed to hold meetings at stated intervals, to which representatives of the map-using public shall be invited, for the purpose of conference and advice. These meetings will be held hereafter on the second Tuesday of January, March, May, September and November of each year.

## Industrial Efficiency

**Japan's Seaweed Pulp Industry.**—That the manufacture of paper pulp from seaweed is proving a profitable undertaking seems evidenced by the fact, reported by Consul General George H. Scidmore, that the only company manufacturing this pulp is building another factory. This concern was organized in December, 1919, and is producing, by a secret process, about 50 tons of pulp daily, which is largely used in the composition of cigarette paper. The new plant when completed will have a daily capacity of 150 tons of pulp. The present price is about 5 cents a pound.

**New Glass Industry.**—Important developments are eventually probable on the northern borders of Dartmoor, in Devonshire, England, in consequence of the discovery of a very large deposit of granulite, a substance of much value in the manufacture of glass. According to experts, "granulite contains not only silica, but potash, soda and alumina, which are necessary in glass making, and its use is not only economical but gives the best results in the production of glassware of the highest quality." It is stated that an experimental furnace has been in use for some time, two others are being constructed, and it is anticipated that the commercial manufacture of glass will commence almost immediately.

**Success of German Fairs.**—The success achieved at the first International Fair held in Frankfurt last fall has led the city authorities and especially the directors of chambers of commerce in several German cities to study the value of fairs as a medium for bringing together buyers and sellers not only in Germany but from all parts of the world with the object of fostering the intensive reconstruction program now occupying the business men of Germany. The city of Stuttgart leads all German cities in the number of fairs scheduled for 1920. A jewelry fair has just been held and reports have been received that it has been a great success for the exhibitors. Another jewelry fair will be held in September. A medical technical fair was held from April 5 to 18; photographic fair, May 2 to 16, and a book fair was planned for June. Fairs will be held in the following cities: Breslau, Danzig, Frankfurt, Cologne, Königsburg, Leipzig.

**Unique British Advertising Plan.**—The Federation of British Industries has devised a unique scheme for advertising home manufactures in all parts of the world. A new steamship to be called the "Federation" is to be constructed by some of the leading firms of the country as an exhibit of British marine engineering. The cargo of the ship will consist of various articles of British manufacture. Representatives of the firms interested will make the voyage for the purpose of showing their goods and interviewing foreign buyers. It is believed that a splendid opening will thus be afforded for extending British commerce in foreign countries. The first voyage will probably be made to the various ports of South America, and subsequent voyages will be made to the Mediterranean, Scandinavia, Baltic ports, the Far East, and Australia. Among the exhibits will be airplanes and airplane parts, and there will also be motion picture apparatus on board for the purpose of showing British films.

**Germany's Wood Problem.**—According to press reports, tremendous sums have been paid in Germany at public sales, not only for the State and community forest products, but also at auctions which took place in private woods. As early as last August the Central Government issued orders to the different State governments that home industries should be first protected in all wood sales. But these Government measures, taken in favor of the general consumer of wooden articles, seems to have had little effect. By selling the wood at a cheaper price to the wood-working industry the State has encountered some loss, notwithstanding which the prices of wood products have increased steadily, as is seen in the constantly rising prices of furniture; the profit remained in the hands of the wood-working industry. In addition to this, a constant export of wood into foreign countries, in spite of the export prohibition, is taking place. In consequence of this, more severe restrictions have been put into force, and it is possible that the wood trade will be licensed for the purpose of putting an end to the wild speculation and profiteering.

*Left:* 85,000-pound cast-steel speed ring of the Niagara turbine, as it comes from the boring mill. *Center:* Shop view of the assembled spiral casing for the Niagara turbine. *Right:* Solid bronze runner for the Tallassee turbine, the largest casting of the sort ever made.

**Some striking parts of the world's greatest turbines**

# Descendants of the Water-Wheel

## Installations for Developing Hydroelectric Power upon a Notable Scale

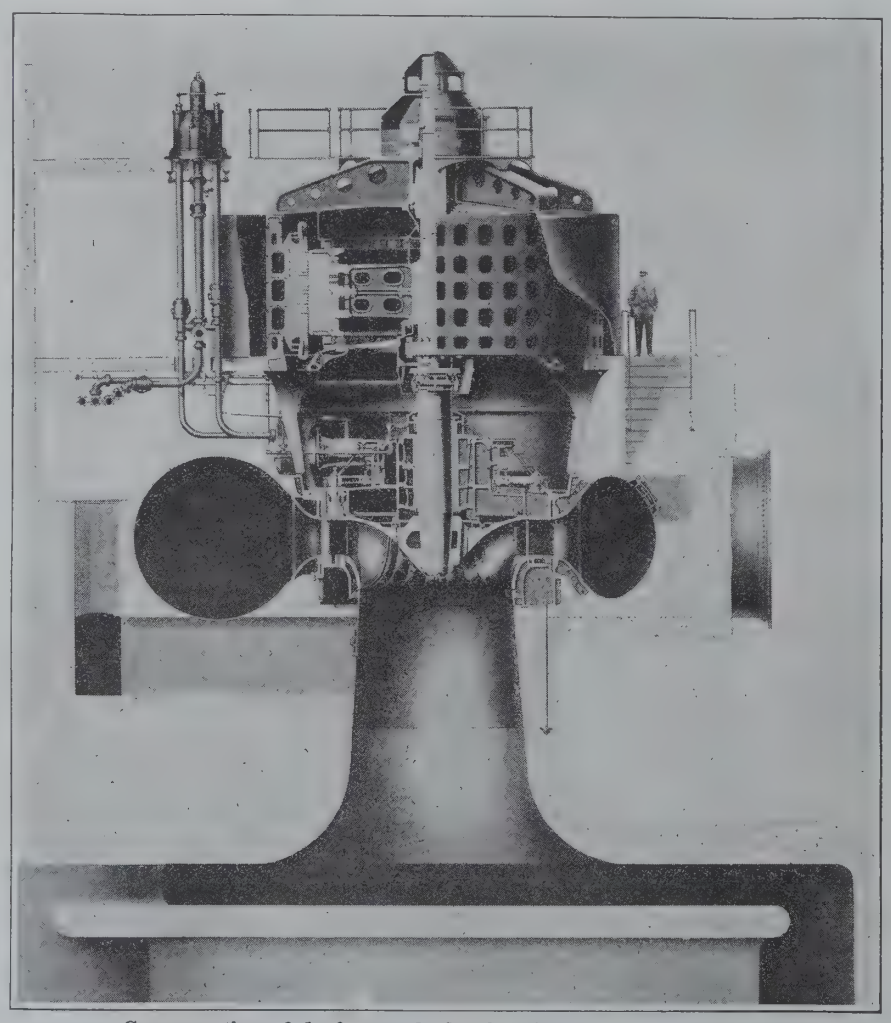
By J. F. Springer

FROM very early times men have sought to utilize the mechanical force exerted by the wind and the waterfall. The undershot water wheel is said to have been the first of the water-power devices, and the breast and overshot wheels are perhaps to be placed next in order. While these apparatus are not to be regarded as efficient in the modern sense, they are by no means obsolete. This is to be explained by the ease and economy with which they may be constructed and installed. It is often a matter of no moment whether there is waste of power water or not. At other times, however, it is of high importance to use the available water power to the greatest possible advantage. In such cases the modern designs must be called into service.

At present modern up-to-date water-power installations belong to one of two types—the Pelton and the Francis wheels. In general, Pelton wheels are mounted on a horizontal shaft; Francis turbines may be mounted upon either a horizontal or a vertical shaft. The Pelton wheel is driven by the force directly imparted by a jet of water. It is classed as an impulse device. In Francis turbines, the drive is effected more or less by reaction.

Notable installations of water turbine units are those at Niagara Falls, N. Y. The development calls for three gigantic units with vertical shafts. These operate big electric generators rotating in horizontal planes. There will be, presumably, three designs of electric generators, since three different concerns are to furnish them. One of these is also to supply the hydraulic unit as well; a fourth concern furnishes the water units for the two other generators. In one of the illustrations is a vertical elevation (partly sectional, partly cut away) showing one of the complete hydroelectric units. This is a vertical unit because the main shaft is vertical. It will be noted that this shaft is in two parts which are bolted together. The lower part belongs to the hydraulic unit and the upper one to the electric generator. Below the shaft is to be seen a great vertical conduit which increases in diameter as it descends. This is the draft tube—the earlier part of it. The spent water passes down and out through the draft tube. The water enters the horizontal water wheel—the runner—from an encircling conduit. This conduit is a very interesting affair. In the present case it consists of a big metal tube of continually diminishing diameter arranged to encircle the runner. Concrete has been the favorite material, but there seems to be some tendency of late to interpose a steel lining between the concrete and the water. The conduit is open pretty much all round its inner circumference. The circular opening is partially occupied by guides which accurately direct the water flowing inwardly from the conduit. The reason the conduit continually diminishes in diameter is that the purpose is to exhaust its supply of water by the time the complete circuit is made. In the figure, this conduit is seen in section at two points, one to the left and the other to the right of the bottom end of the shaft. Other views show the spiral conduit with the guides arranged in its inner circumference; and the framework which holds these guides in place, together with the several guides. The framework with its guide vanes is called a speed ring. In the present case it is of cast steel and has an exterior diameter of 20 feet.

If the reader will now return to the partly sectional view of the whole unit, he may discern the blades of the runner surrounding the bottom of the shaft. This is a tremendously important part of the hydraulic unit, being in fact the water wheel itself. It is secured to the shaft; so that when the water flows into the runner from the enveloping conduit through the openings in the speed ring, not only will the runner be rotated but also the shaft and the attached electric unit. In another view is seen a runner more or less different from the one belonging to the Niagara unit; but the reader will nevertheless understand the general appearance.



**Cross-section of the largest hydroelectric unit in the world, at Niagara Falls, N. Y.**

The Niagara Falls unit is to have an electric capacity of 32,500 kilowatts. When the water turbine rotates at the speed of 150 rotations per minute and the water has a head of 214 feet, its power capacity is 37,500 horse-power. The size of the whole affair may be judged by comparison with the man standing at the head of the steps on the floor of the generator room. In big units of this kind, it is desirable, not to say necessary, to provide brakes so that the whole apparatus may, upon occasion, be brought to rest. The generator is wound for 12,000 volts. This high voltage is necessary for transmission purposes. The rotating part of the generator—the rotor—naturally rotates at precisely the same speed as the runner; this 150 revolutions per minute is considered quite moderate. However, the enormous electric power is nevertheless produced. The moderate speed made it less difficult to design the rotor. If the runner attains "runaway speed"—that is, about 85 per cent overload—the stresses in the rotor will be not greater than one-third the elastic limit of the material. This means that the stresses will fall far short of effecting permanent deformations. The rotor with its shaft weighs 265,000 pounds. The fly-wheel effect developed by the rotor is 10,500,000 pounds per square foot.

In designing the gigantic unit, it was necessary to bear in mind that all the parts had to be lowered over a cliff to the power house at Niagara Falls. Further, even without this drastic requirement, the limitations of the means of transportation had to be kept in view.

The manner of supporting the rotating parts of a big unit like this is of interest. The rotor, the shaft and the runner are the principal items which go to make up the rotating load. In the present case, the support is near the top of the shaft. By referring to the partly sectional view, the reader may note the thrust bearing floating in oil. The outside diameter is 49 inches and the bearing is said to be capable of supporting 465,000 pounds. There are two guide bearings whose function is not to support weight but to maintain the shaft in exact position. One is located just below the thrust bearing. It is 36 inches long and has a diameter of 22 inches. When the unit is running at 150

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## Fifteen Thousand Photographs per Second

By F. Honoré

AROUND 1880, shortly after the gelatino-silver bromide plates came into use, a cannon ball in motion was photographed for the first time. The snapshot showed simply a black line representing the trajectory. Later on, an Englishman succeeded in obtaining a picture of the projectile, which was then reckoned as a great achievement. Several years afterwards Professor Marey, desirous of analyzing the flight of pigeons, had a "photographic revolver" constructed, giving twelve snapshots per second. Today, in the same period of time, the ordinary motion picture machine takes from 20 to 250 views. Usually about fifteen are sufficient to obtain the desired impression. By means of special devices combined for scientific researches, M. Bull, Assistant Manager at the Marey Institute, succeeded in attaining a speed of 3,000 views and by using a process invented by M. Abraham, Professor of Physics at the "Ecole Normale," he is able to obtain photographs today at the rate of 15,000 per second. With more highly improved apparatus, he could theoretically obtain 50,000 and even more. These photographs which we are reproducing without any touching-up were recently presented to the Academy of Sciences. They show the successive positions of a revolver bullet and a 37-millimeter shell on part of their trajectory. We are showing below the manner in which M. Bull obtained this surprising result.

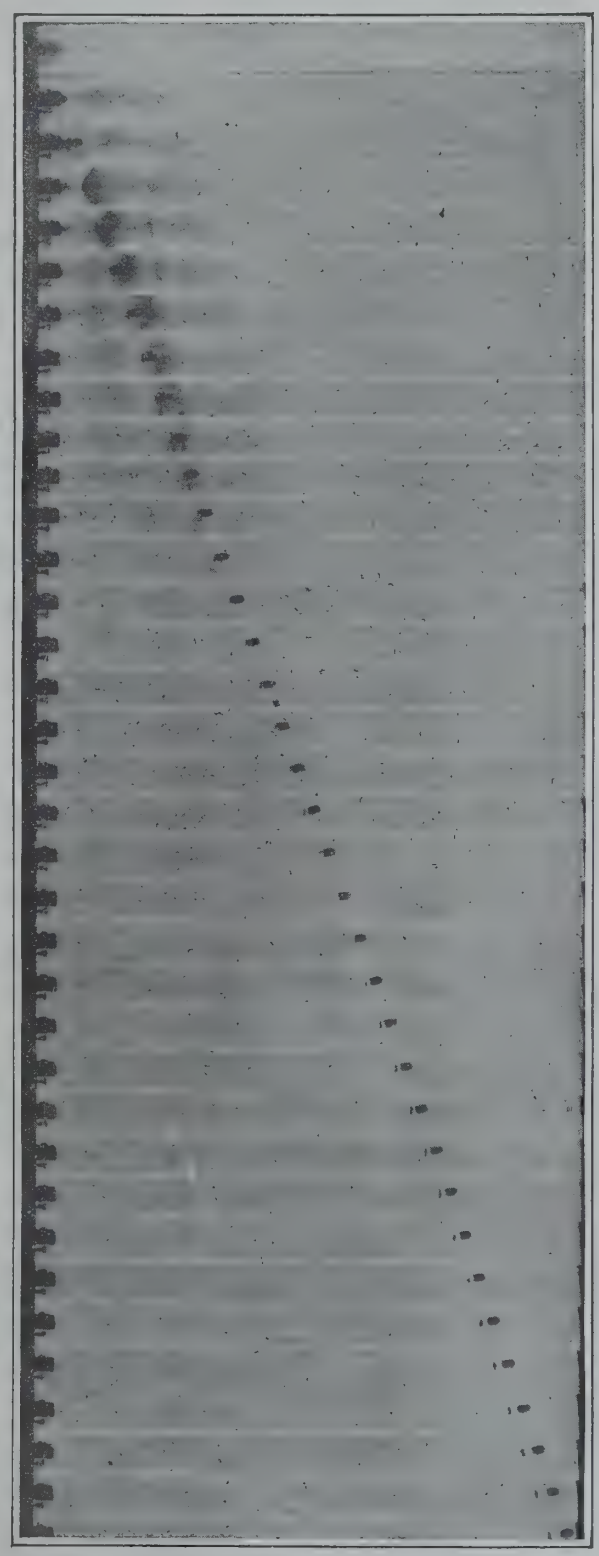
Such a quick photographic impression requires a considerable luminous power. On the other hand, it is impossible to imagine a shutter opening and closing 15,000 times during a second. It is therefore necessary to operate without shutter and use a source of artificial light which appears and disappears automatically in order to give intervals of darkness to replace the closing of the shutter. This source of light is given us by the electric spark of a condenser, a spark similar to the one which produces the Hertzian waves. The condenser may be loaded by means of storage batteries. The tension and frequency of the sparks may be adjusted as desired. With a tension of 10,000 volts and a frequency of from 10 to 15,000 sparks per second, the spark is about one millimeter long. If a film is revolving in a continuous movement in front of the electric source, this film will therefore be impressed 15,000 times per second by a spark. On the other hand, each spark lasting only a few millionths part of a second, the film, regardless of its speed, can be considered as being fixed during each pose and consequently the photograph will be very clear.

M. Bull makes the spark burst in the focus of a concave mirror of about 40 centimeters in diameter which reflects a parallel pencil of luminous rays which is crossed by the projectile. The latter shows a black silhouette (shadow) on the lighted background at the same intervals as those separating two successive sparks. In front of the point it must pass and at the same distance as the mirror a lens concentrates the luminous rays on the objective.

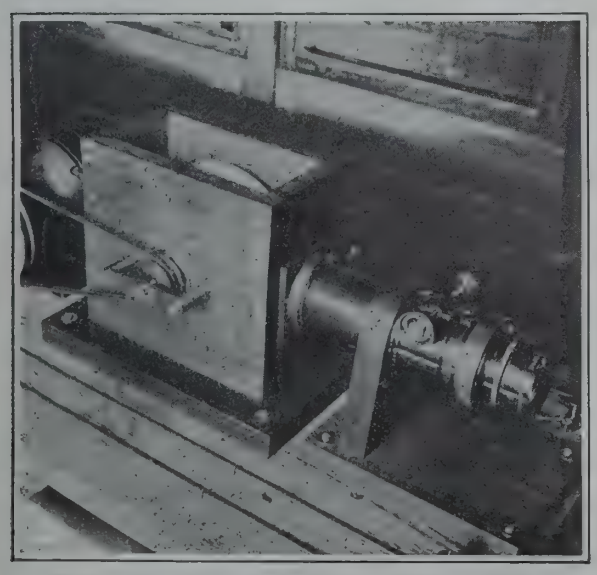
It is now necessary to receive the pictures on the film with a speed corresponding to that of the succession of sparks. The film, which is one meter long, is wound around a cylinder of the same circumference which moves on a horizontal axis and to which an electric motor gives a speed of 3,000 revolutions per minute, or 50 meters per second. The film makes therefore one revolution in 1/50th of a second. If 100 pic-

(*Continued on page 94*)

The old and the new in steel ingot-making



A few successive impressions of a revolver bullet, taken at an exposure rate of 15,000 per second



Close view of the apparatus for rotating the film and controlling the spark

## Better Steel Ingots with Less Waste

By A. R. Surface

IMPROVEMENTS in the casting of steel into ingots are being constantly made but there are still many steel mills which adhere to the old practices. According to the old and long established practice it has been the custom and still is where it is used, to pour the molten steel into iron ingot-molds which are smaller at the top than they are at the bottom.

All steel, unless made direct into castings, is poured into some kind of an iron mold in which it solidifies before being further treated or manipulated. When poured into the old style iron molds, smaller at the top than they are at the bottom, they have the shape similar to the left-hand illustration, which shows such a steel ingot split in two, the original ingot being rectangular in shape. It is seen from this that there is a decided area of hollow or spongy steel extending well down into the ingot, nearly one-third down in fact. This portion of any ingot thus poured is worthless so far as further use for rolling or forging into finished products is concerned. It has to be removed, leaving only a portion of the original ingot available for further manipulation in the rolling mill. The amount of waste in a large steel mill where hundreds of these ingots are poured daily is very large. The discarded portion can only be used for remelting.

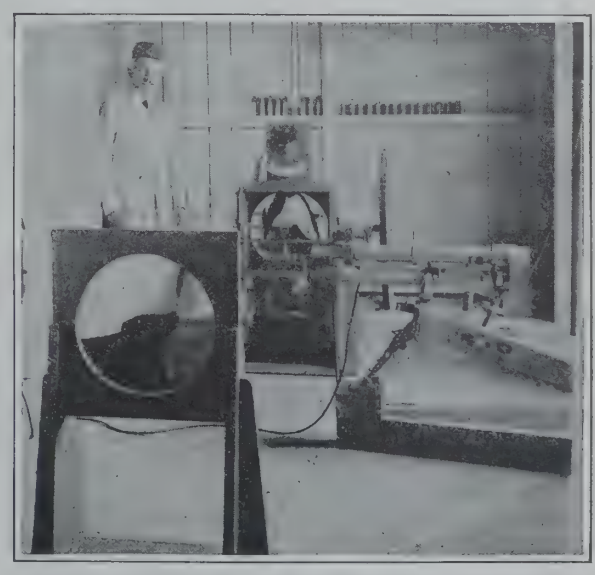
Realizing the waste involved and the advantage possible if this could be overcome, several metallurgists have devised ingot molds to overcome this. The product of one of the most successful, is shown by the other illustration at the right. This is the half of a steel ingot cast in an iron ingot-mold which is larger at the top than it is at the bottom and which uses on the top, when the steel is poured, what is called a "hot top" or sink-head—that is, the top of the iron mold is surrounded with a refractory substance which really builds up or extends the mold a few inches higher. After the steel has solidified in this, the refractory portion is broken away, leaving a protrusion on the end of the ingot.

The advantage of this practise can be readily and quickly seen. Instead of the large hollow spongy portion, called a pipe, which is so evident in the other case, there is in this case only a small hole or pipe which is confined to the extreme upper portion of the ingot and does not extend down into the actual ingot at all. It is plain that the amount of rejected steel in this case is relatively small and also that the quality of steel is considerably better.

It is stated that as approximately 3,000 tons of steel ingots are now produced daily in the United States in these improved molds, the average daily saving by means of this and other patented inventions of this nature is approximately $10,000 and perhaps much more.

## Chemical Warfare Service School

CHEMISTS generally have been gratified to learn that steps are being taken to establish a school where men may be trained for the Chemical Warfare Service and where recruits can be given the sort of training which will be very serviceable to them in peace times. Men who are without sufficient resources to gain a technical education can in this way gain the training which will be useful to them in war or peace. From the standpoint of chemical industry, such men would be found suitable as foremen and possibly superintendents in chemical plants.



General arrangement of the camera and appurtenances for 15,000 exposures per second of a moving projectile

# Lubricating the World

## Some Facts That Show Why We Are Short of Lubricating Oil, and a Few Suggested Remedies

By Eben Griffiths

THE world today is facing a shortage of all petroleum products. We have heard much of this shortage as affecting fuel oils, gasoline, etc., which today form an important part of the world's fuel. Another important phase of the problem is that of lubricating oil. This is the Mechanical Age. Power production has developed throughout the world to a remarkable state of efficiency. Power production demands lubrication, and we know that lubricating oil, like practically every other commodity, is selling today at prices far above what we used to consider the normal range.

What are the reasons for the present scarcity and high price? Is there a remedy in sight? These are the questions that are uppermost in the mind of every man who is using lubricating oil, whether on his automobile, his tractor, or on power machinery.

### Where the Demand Comes From

The answer to the first question will be found in the old-fashioned law of supply and demand. Lubricating oil is scarce and high because more people are trying to buy it than can be accommodated without severe strain on the available supply. Such a condition must result in scarcity and a high selling price.

The present tremendous demand for lubricating oil comes from two sources: First, there is a big demand for American lubricating oil in foreign countries; second, there is increased industrial and automotive development in the United States.

During the war producers of lubricating oil looked forward to peace as meaning a lessening in the demand for lubricating oil abroad. It has not worked out that way; for whereas, during 1918, the total exports of lubricating oil were 257,317,253 gallons, in 1919, when a decrease was expected, exports jumped to 277,591,158 gallons. That condition is typical of what has happened in most lines since the armistice was signed. The demand for lubricating oil and other products for reconstruction and industrial purposes under peace conditions, has been greater than the demands for war purposes.

The same thing has happened at home. Although industry was straining every nerve during the war to produce war materials, there has apparently been no decrease in production since peace was declared. While certain industries have slowed down, others have come forward at a rapid rate, with the net results that today the domestic demand for lubricating oil is greater than it has ever been before. So much for the conditions governing demand. Now let us turn for a moment to the consideration of the sources of supply.

### The Oil Supply

First of all, in considering our present supply we have to remember that when peace was declared, the oil industry had been straining every nerve to supply petroleum products for carrying on the war. Reserve stocks had been exhausted and we entered the peace period practically on a "hand-to-mouth" basis, so far as available oil stocks were concerned.

In the meantime, foreign sources of supply had been shut off. Russian crude oil is for all practical purposes, not available. The same is true of the Galician and Roumanian fields. The United States is today supplying the great bulk of lubricating oil used by the world.

On the other hand, production had been speeded up somewhat by war demands. New fields had been exploited. New wells had been opened up. But the increased supply was not equal to the increased demand. The result has been that today the better grades of crude oils are comparatively scarce. It naturally follows that they are high in price.

Four or five years ago, Pennsylvania crude oil sold for $1.35 a barrel. Today it is quoted at more than $6 a barrel, and it is usually necessary to pay a premium on top of the listed price to secure crude oil in any large quantity. Other crude oils have advanced in the same way. And the end is not in sight.

This, then, is a picture of conditions as they are today: A tremendously increased demand for lubricating oil at home and abroad finds reserve stocks exhausted, foreign oil fields out of the market, and production in the United States increased but not enough to take care of the increased demand.

### The Remedies

What are the remedies for the present situation?

First of all, we have the natural law which tends to harmonize supply and demand. High prices in themselves are a deterrent to use. We can safely count on some readjustment from this factor.

Much depends upon the foreign situation as regards credits and exchange. As credits to foreign countries are cut down it will naturally follow that less oil will be bought for export. It is also reasonable to assume that foreign production will soon become an important factor again. But the big remedy lies in an increased activity on the part of American capital in developing oil resources at home and abroad.

Much has been written about the threat to America's leadership in the oil industry. It has been said that England and other countries are endeavoring to usurp America's place as the leader in oil production. Of course, this is mere speculation, and looks far into the future in an effort to predict possibilities and not probabilities.

Few of us realize how great is America's leadership today in the production of oil. The United States today is producing about 70 per cent of the world's supply of petroleum. About 16 per cent is coming from Mexico, and about half of this Mexican supply is being produced by American capital. The other 14 per cent is coming from Central and South America, Russia, Roumania, Galicia and other spots of the world's domains. In 1916, the marketed production of petroleum products of the United States was 301,000,000 barrels; in 1917, 335,000,000; in 1918, 356,000,000. The United States Geological Survey estimates our unproduced but recoverable oil in January, 1919, as 6,740,000,000 barrels.

While the above does not indicate that the United States is in danger of being surpassed as a producer of petroleum, it is a fact that this country must be alert to the situation, and must not sit idle while other countries develop their resources.

America's opportunities are: To conserve and to develop the vast oil resources that still remain in this country; to enter whole-heartedly into the development of oil lands in foreign countries, especially in Mexico, Central America and South America; to discover the most practical and economical way of developing the shale oil deposits that lie in vast quantities in the Rocky Mountain states; and to urge and promote economy and efficiency in the handling and use of petroleum products.

### Oil Waste

This matter of the economical use of our oil supply is one of vast importance, not only to the country as a whole, but to each individual user of lubricating oil. Much of this waste occurs in the oil fields. Unlimited supplies in the past have brought about wasteful methods of recovering and storing oil. Vast quantities of oil run to waste every year in the oil fields. Oil men are today keenly alive to the situation, and able brains are devising ways of eliminating this waste.

But the waste which comes closer to most of us is that in the use of petroleum products. In lubricating oil alone, large quantities are wasted every year through unintelligent use. In almost every industrial plant more lubricating oil is used than is necessary to secure efficient lubrication. Oil is bought in quantities, and the application is usually in the hands of someone who is not especially interested in operating economy. He is interested, however, in "avoiding trouble," and his own idea of how best to avoid trouble is to "pour on plenty of oil." In that belief, lies one of the greatest fallacies in the world. "Plenty of oil" does not necessarily mean good lubrication. Correct lubrication consists of applying the right oil in the right places in the right way.

There are certain definite rules by which every user may help to eliminate waste in lubricating oil whether he is operating an automobile, a tractor, or an industrial plant. Perhaps the most important of all is to buy the correct oil for the purpose for which it is intended. This may sound like an academic statement, but it is strictly a matter of dollars and cents and oil conservation. We will all agree that no one oil will lubricate all types of machinery. We wouldn't use the same oil in a steam cylinder as we would on the shafting. We wouldn't use the same oil in our automobile engine as we would in the rear axle. But the difference does not stop there. For practically every lubricating need in any machinery, there is a correct oil, and there are hundreds of incorrect oils. If we use the correct oil, in nine cases out of ten we will use less of that oil than we would of an incorrect oil. In addition to that, there are resulting advantages in reduced friction, increased power, etc., which we need not go into here.

A second fundamental point is to use only high quality oils. In lubrication, perhaps as much as anywhere else, it is axiomatic that quality means true economy in the long run. High quality oils may cost more by the gallon, but they will cost less by the year, and we will be helping to eliminate waste of oil by using less gallonage.

Third, it is essential to install mechanical lubricating devices on machinery. We have already spoken of the fallacy that the more oil we put on the better lubrication we secure. One drop of oil at regular intervals will provide better lubrication than a lot of oil poured on at irregular intervals. For practically every lubricating requirement in every plant, there is available on the market a mechanical lubricating device which will supply regular and constant lubrication to the frictional surfaces without danger of too little lubrication and with the absolute elimination of waste in applying the oil.

Finally, we must prevent leakage from barrels or packages. A great deal of oil runs to waste every day in garages and in plants through careless handling and improper storing of barrels and packages. A leak of one small drop of lubricating oil per second from the faucet of a barrel means a loss of 34 gallons in a month.

The above suggestions are typical of many that might be made for the conservation of lubricating oil. It is essential that the American people practise this conservation in order to help bring about a return to a normal basis. Oil interests today are actively at work on remedies for the present situation. In order that they may have time to work out this problem properly, economy in the use of our present supplies is most important.

*THE acute character of the petroleum situation is, as yet, apparent to the general public only in the elevated price of gasoline, and in the occasional difficulty in buying this fuel at any price. We have touched upon several aspects of this in recent issues; but gasoline, as we have already pointed out, is only one of the petroleum derivatives. Just to what extent the shortage is felt in other directions, how serious the situation is outside the matter of gasoline, and what remedies may be looked for, are topics of importance second only to that of gasoline. So far as they relate to the field of lubricating oil, they are discussed in this article by a man who is thoroughly familiar with that field.*—THE EDITOR.

## The Detachable Broom Handle

THIS is the day of high-living costs—but it is also the day of new and crafty ways of sidestepping the onslaughts of the ugly ogre. The latest device to enlist on the side of the people is the detachable broom handle.

At first thought the broom handle seems inconsequential. Isolated and individually it is. Multiply it by some fifty millions or more, which probably approximates the number of brooms sold yearly in the United States, and you have something quite different.

The detachable broom handle is a brand new idea and it is taking. At the present time there is a factory in Vermont devoted exclusively to manufacturing brooms with this type of handle. The handle is of wood fitted into a metal holder that clamps easily on to the brush of the broom. The metal part is light, but very strong, being securely welded by the oxy-acetylene process, which not only makes it rigid but allows the entire piece to be neatly finished.

# Some Observations on Eggs

## Scientific Principles That Enter Where Least Expected and Are Carried Out Unrecognized

By John T. Bartlett

APPLIED science enters into the daily life of the city dweller at every turn; but the city dweller never has to worry about it. His applied science is attended to for him by somebody else, and comes to him in neat packages so that all he has to do is to turn a switch or lift a finger. But the farmer lives in smaller communities, much closer to nature; and while vast achievements have been recorded that go to make his life less isolated and less laborious, the general statement may still be made with a good deal of confidence that he must for the most part attend to his own applied science. He even has to go further than that in a good many cases and lay his own foundation of observational and experimental work—he may not realize that he is laying scientific foundations for future use at the moment, but that is what it really comes to. There are many illustrations that might be adduced to show that all this is so, but no space in which to adduce them all is available. A couple of the more striking will have to suffice and it happens to be convenient to take them from the same department of farming.

Take the matter of getting to market with the fragile hen-fruit. Scientists and inventors galore have worked on this problem, as the records of the patent office will demonstrate. Yet even before them, the farmer himself had learned that eggs may be driven to town without loss if they are packed in oats. The handy firkin is the rough-and-ready container, and packing is at hand in the feed room.

No matter how rutty, rocky and crooked the road to be traversed is, the contents are safe in this humble berth. The oats absorb the violent joltings and swayings. The eggs are traded in at the store without so much as a small crack. The packing is carried home and fed out. Then the storekeeper, having resort to an invention of comparatively recent years, the American egg case, opens carboard "fillers" and packs his fragile purchase for shipment to the large city market, where the eggs are either distributed for immediate consumption or placed in cold storage.

We in the United States are given to invention, and our egg case with its paper fillers is characteristic. Canadians are much like us. They use the same case we do. But because traffic in eggs thus packed reaches enormous annual proportions, we must not presume that this method is the only one followed or even the only quite practical one. It is not a perfect method, either. In fact, what the ultimate universal method of egg-packing will be, nobody knows, though naturally we Americans believe it will be of our development and in the direction already indicated.

It is entirely possible to use in a wholesale way, shipping long distances, the packing method which American farm-wives still use in carrying eggs to the village store. Chinese districts, for example, utilize two compartment cases in which oil cans have been shipped, and the packing material is hulls which act much as do oats. The Chinese second use of a commercial package is also paralleled in this country, where flour barrels are commonly used for apples and sacks for various products over and over again.

There was recently held in London an egg-and-poultry conference at which egg-packing methods were a foremost topic. We know our American method is not perfect, of course, but we are wedded to it. Its principal weakness is the fact that while eggs are not arbitrarily sized, the cardboard compartments must be. When eggs were much cheaper than now, this disadvantage was not of much consequence. The occasional breakage resulting when an egg was too large for the standard compartment did not matter much. A careful Yankee poultrykeeper shipping hatching-eggs in cardboard compartment containers is sure to wrap each egg loosely in newspaper fragments. There is an opportunity for some ambitious inventor to perfect our egg-packing materials, never losing sight of those important considerations, light weight and convenience. In rapidity of handling no method is the equal of ours.

The Danish way is to pack eggs in wood wool, the name given to a very fine kind of excelsior. The Danes are satisfied with their method. The bulky case in which they ship is so heavy that several men together must handle it. The Danish poultrymen find this works in their favor, preventing the careless, rough treatment, resulting in breakage, to which the Irish and American cases, both one-man affairs, are subject.

The writer has no data on the point, but it is a reasonable assumption that the capacity of the American case—thirty dozen— was determined in the beginning by the consideration which, in one respect, now works against it—a sensible size for the average man to handle unaided.

The Irish use still another packing method. They ship eggs between layers of straw. These layers are substantial, and if the packing is conscientious and after-handling reasonably careful, the eggs arrive at their destination with every individual specimen in good order.

While on the subject of eggs, it might not be out of order to point out that the big laying capacities which hens develop nowadays are also the result of more or less scientific investigation, of much the same impromptu sort that the farmer has given to the transportability of the eggs after their production. There is indeed a scientific principle involved in the unnatural stimulation of the egg-producing organs, which is often lost sight of, but which the farmer knows a good deal about, from his observations on domestic and wild fowl alike. For the domestic chicken was originally wild, and if we study the wild birds carefully we see the same principle, the mere existence of which has eluded the notice of most persons.

Take a recent case on a Western irrigated farm, where a meadow lark's nest, concealed in an alfalfa

(Continued on page 94)

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### First Consideration for the New York State Barge Canal

To the Editor of the SCIENTIFIC AMERICAN:

I am interested in the article in your issue of June 19th, regarding a greater ship canal via the St. Lawrence to the sea, which to a novice may appear as an easy financial problem, because of the great sums of money which were so quickly raised for war emergency. I agree with you that our efforts should be expanded on the New York State Barge Canal, which is now in operation. Its promoters are now struggling with the State Finance Department to get a little more money to complete the general plan which includes the erection of terminal elevators. This will thoroughly relieve the East and West traffic between the Great Lakes and the sea.

I am a close student of this question of Lake-to-the-Sea Canals, and have an intimate knowledge of both routes. My fifty years of shipbuilding and maritime experience includes the building of more than 150 steel ships and the operating of many of them on rivers, canals, the Great Lakes and the ocean, and of some of them around the world. Before the Lower Canals were built, I personally built and took three large steel ships through the St. Lawrence Rapids to the sea; and some of these same ships, with others, I cut in two and brought back again to the Lakes. Before the Lower St. Lawrence Canals were finished, I ran the Rapids of the St. Lawrence in these interests more than twenty times. I personally sounded the shoal spots of the channel, except in the rapids, from Lake Ontario to Montreal. I have been called upon as expert witness by the Canadian Privy Council to give evidence relative to this outlet to the sea.

Just before the war I came from Liverpool to Montreal in order to study the gulf and inlet from the sea by use of ship's charts, and was given the privilege of viewing the river from an elevated position on board. The gulf is noted for its high tides and for the snow and fog in spring and fall, making it dangerous navigation. A ship wrecker of my acquaintance had twenty-two ship wrecks to salvage there in 1919. Notwithstanding this, doubtless there may some day be a large ship canal there, and also the original water route via the Ottawa River and Lake Nipissing between Montreal and Lake Huron. This route was intensively operated between Montreal and the Northwest from 1730 to 1830, and the success of the New York Canal may some day call for this as an outlet for ships.

For the past few years I have made trips along the construction of the New York Barge Canal, and have just returned from there. I have seen every lock in the main canal in operation. The slowest or deepest lock on the canal is at Little Falls, where I saw a tug and barge locked through in less than twenty minutes, without special effort. A large ship would take less time. I think ships could satisfactorily use the canal that measured 300 x 43 x 24 feet; that would carry about 5,000 net tons on the Lakes and coast, and through the canal about 4,000 cubic tons, or as much as 116 full-size box cars. When the state has granted a little more money to finish up the work, making passing stations on long levels, so that the large ships can pass each other, it may be possible to pass in one direction twenty million cubic tons of cargo in 220 days of the year. The effect of this on the cereal crop of the Great Lakes basin will amount to more than twenty million dollars per year at one cent per bushel. The amount of package freight from manufacturing companies will also be a large tonnage for Eastern consumption and export.

The building of the St. Lawrence Canal, as advocated by its boomers, would cost more than to build a larger canal from Oswego to Albany and New York, the route for which, including a connecting link from Lake Ontario to Lake Erie, has already been surveyed by our government engineers. The Welland Canal, to cost about seventy-five million dollars, is only about 25 per cent done, and will take many years to finish. When done, it will make a splendid outlet for both Canadian and United States tonnage via Oswego through the Barge Canal to New York.

Because of hostile propaganda against the Barge Canal the public has a wrong impression of this fine, useful, free waterway to the sea. An eminent engineer, who did much of the designing and planning of the Panama Canal and also of the New York Canal, tells me that the New York Canal is the greater of the two in work and skill. It is now in operation, and in one or more years will have 5,000-ton ships passing through that can trade to all parts of the world. When in smooth running order I think it will have more Canadian Lake ships pass through it than to Montreal, the Lake ships on both sides collecting cargoes at Lake ports for Eastern consumption and export, and returning with all kinds of imports. They will also bring U. S. coal from Utica and Watkins, the canals on both side being free for both U. S. and Canadian ships.

I think those who are agitating the St. Lawrence outlet have not fully considered the enormous opposition to it from the many trunk line railroads that parallel that waterway in both the United States and Canada. They have forgotten, also, the transfer points at the terminals: Port Colburn, Kingston, Montreal, Quebec, Halifax, St. John, Portland, Boston, New York, Philadelphia, Baltimore, Norfolk, etc. They should consider the Southern and Western States and provinces, which will be indifferent to, or against, the St. Lawrence project, at least until the *New York Ship Canal*, as it should be called, shall have demonstrated its value.

ALEXANDER MCDOUGALL.

Duluth, Minn.

### The Cruiser Courageous

To the Editor of the SCIENTIFIC AMERICAN:

In glancing through some back numbers of the SCIENTIFIC AMERICAN I found in the number dated December 21st, 1918, a picture of a two-funneled cruiser fitted as an airplane carrier described as the "Courageous." The SCIENTIFIC AMERICAN for June 21st, 1919, however, prints plans and profiles of various British ships which show the "Courageous" with only one funnel and the light cruiser "Raleigh" with two very like those of the aircraft carrier previously illustrated; so it seems certain that the so-called "Courageous," with two funnels, is really the new "Vindictive," originally named "Cavendish."

R. H. FITZ-HERBERT.

Havelock N. Hawke's Bay, New Zealand.

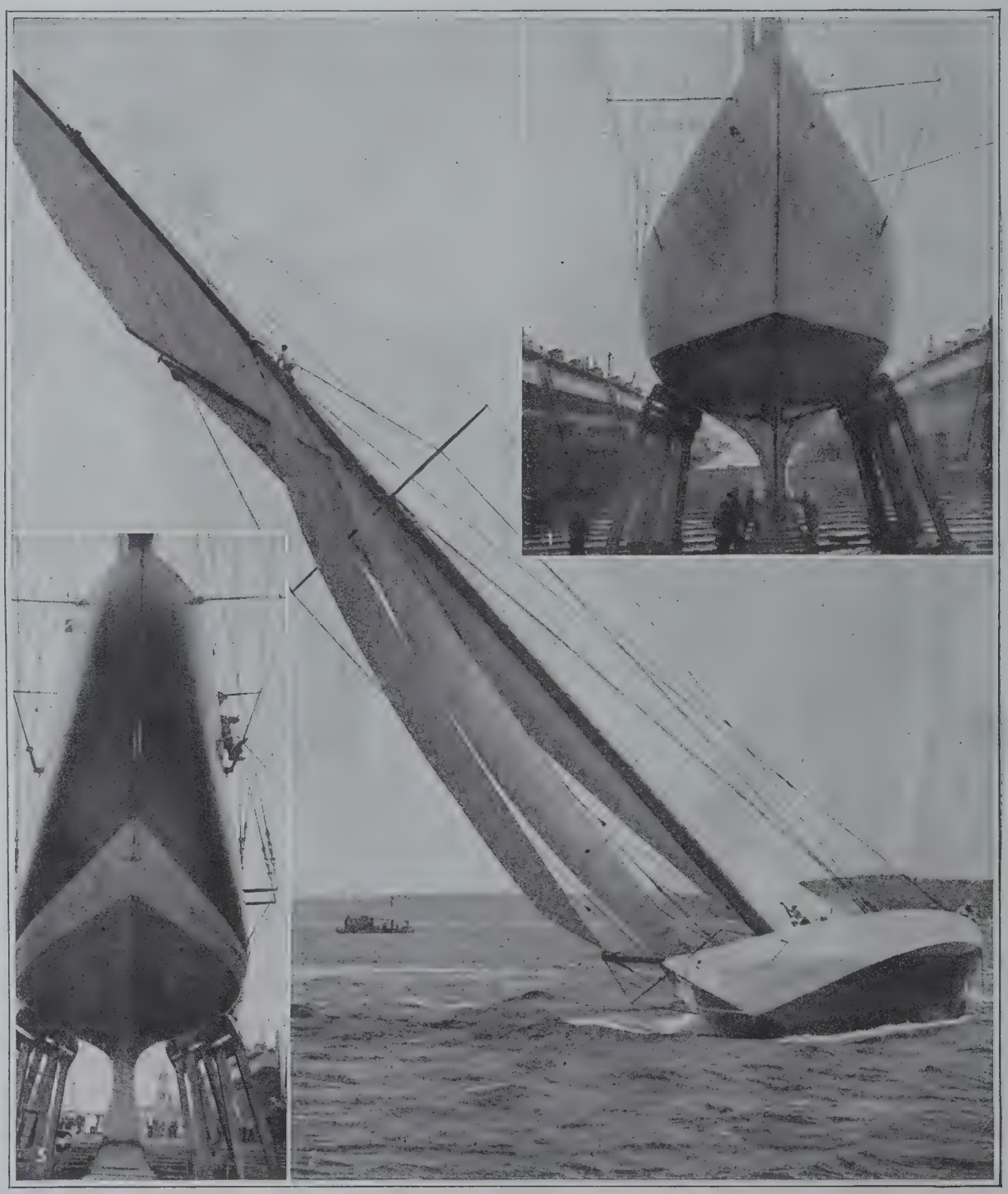
# Cutter Versus Sloop

## The Past Thirty-Five Years of Racing for the America's Cup

WITH each successive series of races for the America's Cup the SCIENTIFIC AMERICAN has published a set of diagrams of the contending yachts; and this year the presentation is brought up to date by the addition of the profiles and midship sections of the challenger and defender of 1920. The period from 1885 onward is the most interesting for the reason that the "Puritan" was the first defending yacht built specially to meet the challenger, and from the time of the "Thistle" onward all the British yachts have been built with a special view to "capturing" the Cup. Previous to 1885, the majority of the challenging and defending yachts were schooners. From 1885 to 1920 all of the boats, both British and American, have been single-stickers.

The "Genesta" (1885), the fastest of the British cutters of her day, was a thoroughly representative yacht. Because of a British rule of measurement which put a heavy tax upon beam, the British cutters were very narrow in proportion to their length and depth. They were heavily ballasted with lead, and they carried only a moderate amount of sail for their large displacement. The "Puritan," a typical American sloop, by Burgess of Boston, was a yacht of great beam, shallow draft and small displacement, carrying a large sail spread in comparison to her displacement. Thus, the "Genesta" spread 7,141 square feet on a displacement of 141 tons; whereas the "Puritan" of only 105½ tons carried 7,370 square feet. Apart from her great beam and shallow draft, the sloop was equipped with that distinctively American contrivance, the centerboard, which, in sailing against the wind, was lowered in order to give sufficient lateral plane to keep the yacht from making leeway.

The "Galatea" (1886), a big, heavily-built cruising cutter, should never have been sent over for the Cup. She had won but a few races on the other side, and although a very handsome cruiser, she had neither the handiness nor speed that would warrant her being matched against the fleet American sloops. "Mayflower" was designed by Burgess especially to meet her. She had a foot more beam and about a foot more draft than "Puritan," and on a displacement of 110½ tons she spread 8,800 square feet of sail as compared with 7,387 square feet of sail for the "Galatea," whose displacement was over 157 tons.



Left: "Shamrock IV." Center: "Resolute" closehauled. Right: "Resolute."

At this time the British abandoned their former rule of measurement and substituted one based upon length and sail area. With the tax upon beam removed, Mr. Watson designed the "Thistle" of 138 tons. The value of beam for sail-carrying was shown in the fact that the sail area went up from 7,387 feet in "Galatea" to 8,968 feet in "Thistle." Burgess, of Boston, designer of the "Puritan" and "Mayflower," brought out the "Volunteer," a sloop of 134 tons' displacement and spreading 9,271 square feet of sail. As compared with "Mayflower," the beam was decreased four inches and there was a slight increase in the draft. It should be noted that the "Volunteer" was built of steel. In all three series of races the American sloop proved to be more than a match for the British cutter, whose lateral plane was so greatly cut away that she could not point with the American boat.

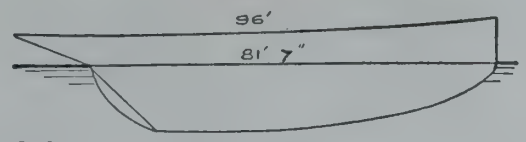
Between 1887 and 1893, Watson had designed for the Prince of Wales, afterward King Edward VII, a very successful cutter, the "Britannia," which swept the boards in all the European races; and for the challenger of 1893, he designed "Valkyrie II," which was of the "Britannia" type. By the "Britannia" type we mean a cutter in which the lines are carried well out into the overhangings and all superfluous deadwood is cut away. "Valkyrie II" of 148 tons' displacement spread 10,042 square feet of sail. She had over two feet more beam than "Thistle," or 22½ feet; and her draft was between three and four feet greater. To meet her, Herreshoff designed the "Vigilant," a sloop with the enormous beam of 26 feet, four feet less draft than "Valkyrie II," and with 1,300 square feet more sail. Like all her predecessors, she was a centerboard sloop. In this series of 1893 the British began for the first time to show a speed that compared favorably with our American sloops. In the third race to windward and leeward, "Valkyrie II" beat the "Vigilant" to windward, but lost by 40 seconds on the run home because in the strong wind two of her spinnakers were blown away. The following year, "Vigilant" was taken over to race in English waters, and was frequently beaten by "Britannia." Hence it is not surprising that in the series of races of 1895 Herreshoff should have dropped the centerboard and built a yacht which in its profile and cross section approximated the new and very successful "Britannia" and "Valkyrie" type. His change from centerboard sloop to keel cutter was a logical development from his success in the smaller classes with "Gloriana" and "Wasp," which anticipated many of the features which characterized the "Valkyrie" and "Defender."

Just as Herreshoff was influenced by "Valkyrie" in designing the "Defender," so was Watson influenced by "Vigilant"; for "Valkyrie III" had the great beam of 26 feet 2 inches, or slightly more than that of "Vigilant." She had something of the full bilges and shallow hull of the American sloop, and on a displacement of 155 tons, spread 13,026 square feet of sail. "Defender" was built with a bronze underbody and aluminum-alloy topsides. She was a remarkably light boat in construction and weight, and on a displacement of 143 tons, she spread 12,640 square feet of sail.

For the races of 1899, Fife, a designer of scarcely less distinction than Watson, was selected to design "Shamrock I"; and to meet her Herreshoff turned out the "Columbia," probably his most successful yacht. In the next series of 1901, Watson was called in to design "Shamrock II" and the wonderful "Columbia," proving better than Herreshoff's new "Constitution," was selected once more for the defense of the Cup. "Shamrock II" proved to be by far the best boat sent to this side, as is proved by the small margins by which she lost the 1901 series. It is the opinion of many American yachtsmen that her failure to take the Cup was due to poor handling in the races. In 1903 Fife was called in again, and he turned out one of his characteristically beautiful boats with a very sweetly turned and admirably proportioned hull—a powerful craft spreading 14,337 square feet of sail. To meet her Herreshoff, influenced no doubt by the great speed shown by "Independence" with her scow-shaped hull, built a most extreme boat, the "Reliance," which on a waterline length of 89 feet 8 inches showed a total length of deck of 145 feet, and spread the enormous area of 16,169 square feet of sail. "Shamrock III" made a good fight for the Cup.

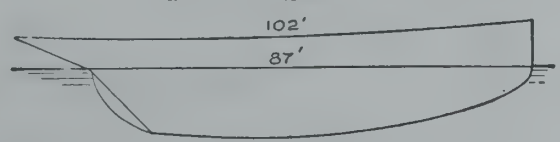
For the 1920 series, it was agreed that, for the sake of economy and all-round convenience, the length of challengers and defenders should be restricted to 75 feet on the waterline. The two boats are built under a rule which aims to prevent such extreme racing craft as "Reliance" and "Shamrock III." A premium is put upon displacement, and a heavy tax upon the sail and upon shallow-bodied, full-ended boats of the "Reliance" type. Herreshoff, in "Resolute," has turned out a small boat that aims to get every advantage possible from the rule. Nicholson, on the other hand, has accepted the penalties of the rule, particularly as regards sail area, of which his "Shamrock IV" carries about 20 per cent more than the defender, "Resolute."

## GENESTA — 18



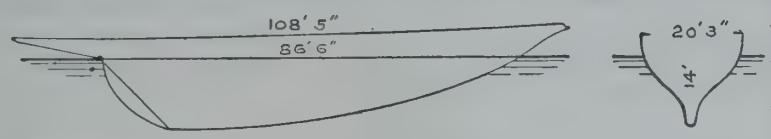

Sail Area 7141 Sq. Ft.

## GALATEA — 18



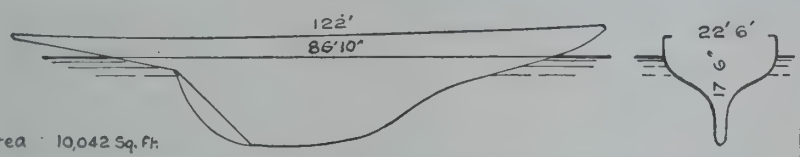

Sail Area 7505 Sq. Ft.

## THISTLE — 18



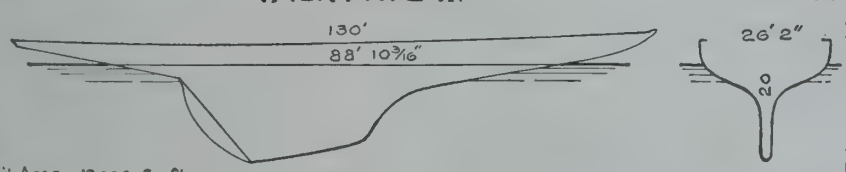

Sail Area 8968 Sq. Ft.

## VALKYRIE II — 18



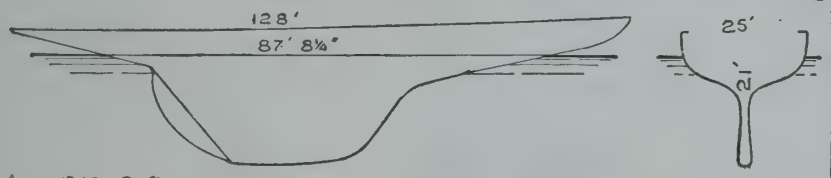

Sail Area 10,042 Sq. Ft.

## VALKYRIE III — 18



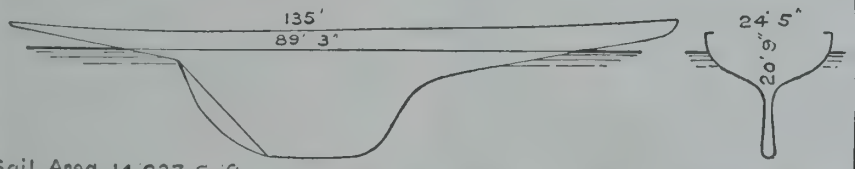

Sail Area 13,026 Sq. Ft.

## SHAMROCK I — 18



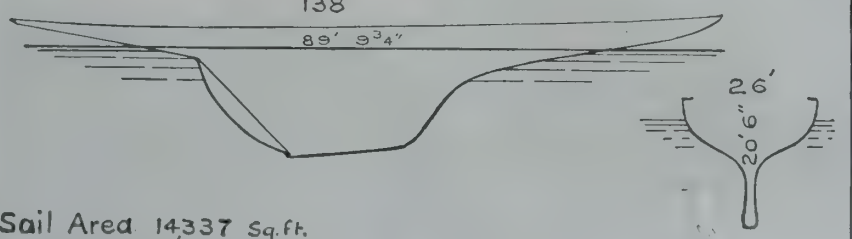

Sail Area, 13,491 Sq. Ft.

## SHAMROCK II — 19



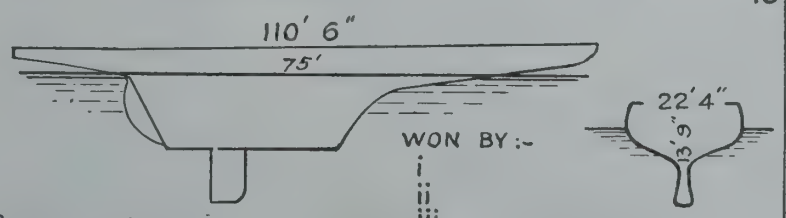

Sail Area 14,027 Sq. Ft.

## SHAMROCK III — 19




Sail Area 14,337 Sq. Ft.

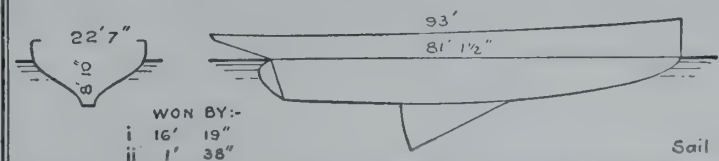
## SHAMROCK IV — 19




WON BY:-
i
ii
iii
iv
v

Sail Area 10,500 Sq. Ft.

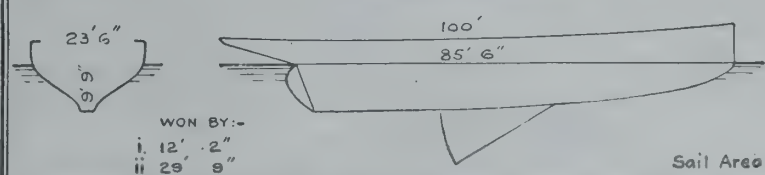
## 85 PURITAN




WON BY:-
i 16' 19"
ii 1' 38"

Sail Area 7370 Sq. Ft.

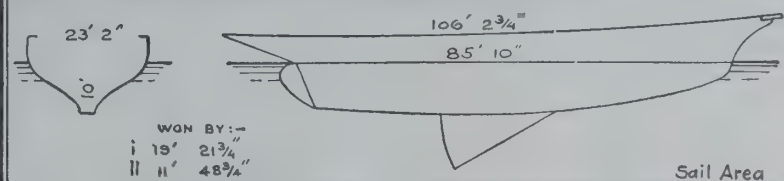
## 86 MAYFLOWER




WON BY:-
i 12' 2"
ii 29' 9"

Sail Area 8824 s.ft.

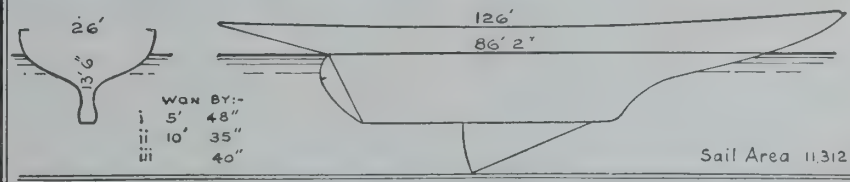
## 87 VOLUNTEER




WON BY:-
i 19' 21 3/4"
ii 11' 48 3/4"

Sail Area 9271 Sq. Ft.

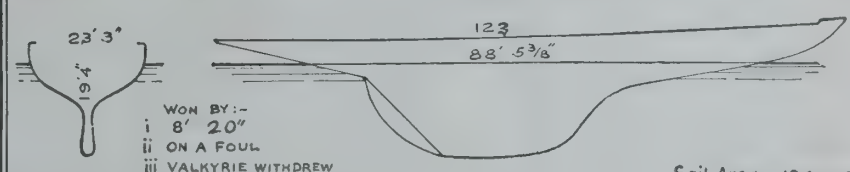
## 93 VIGILANT




WON BY:-
i 5' 48"
ii 10' 35"
iii 40"

Sail Area 11,312 Sq. Ft.

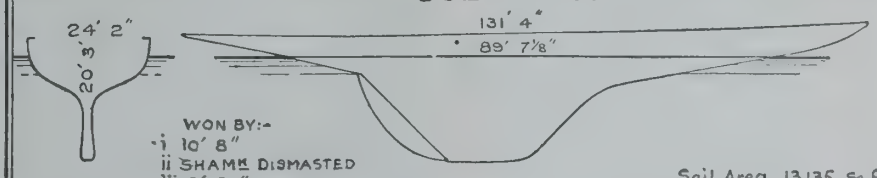
## 95 DEFENDER




WON BY:-
i 8' 20"
ii ON A FOUL
iii VALKYRIE WITHDREW

Sail Area 12 640 S. Ft.

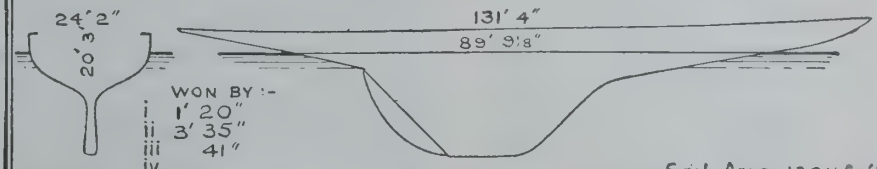
## 99 COLUMBIA




WON BY:-
i 10' 8"
ii SHAMR. DISMASTED
iii 6' 34"

Sail Area 13,135 Sq. Ft.

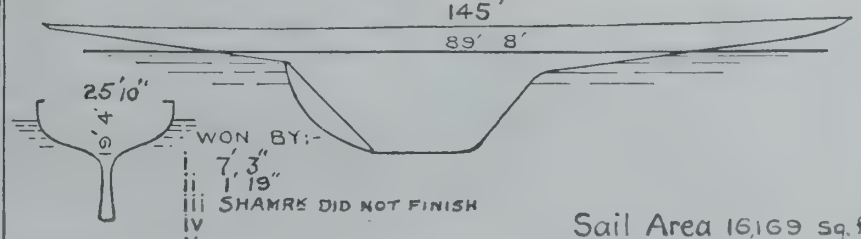
## 01 COLUMBIA




WON BY:-
i 1' 20"
ii 3' 35"
iii 41"
iv
v

Sail Area 13,211 Sq. Ft.

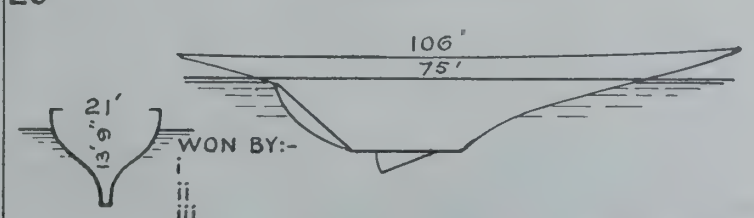
## 03 RELIANCE




WON BY:-
i 7' 3"
ii 1' 19"
iii SHAMR. DID NOT FINISH
iv
v

Sail Area 16,169 Sq. Ft.

## 20 RESOLUTE




WON BY:-
i
ii
iii
iv
v

Sail Area 8,700 Sq. Ft.

DEVELOPMENT OF CHALLENGERS AND DEFENDERS OF AMERICA'S CUP FROM 1885 TO 1920

*Left:* Placing in the molds the hot syrup used in the manufacture of hard candies. Making hard candies is merely a miniature reproduction of ordinary foundry practice. *Center:* Slabs on which color and flavor are added to the fondant filling for chocolates. *Right:* The Jordan almond machine, where the nuts get their coating of hard sugar.

**Making sweets for the biggest candy-consumer among the world's nations**

# Uncle Samuel's Sweet Tooth

## Manufacturing Candy on a Huge Scale to Meet the Demands of the American People

By H. A. Mount

WE haven't the statistics, but we will venture the statement that if all the candy the average American girl eats in a year were placed end to end, it would reach the enormous distance of nearly half way around her appetite. But we can't blame it all on the boys and girls. Every member of the family has a hand in it and the total amount of candy consumed in the United States reaches the proportion of hundreds of tons a day. We are the greatest nation of candy eaters on earth and it has been said that all of the rest of the world combined eats less candy than we do. Our appetite for sweets supports a large industry, but it is not the purpose here to deluge you with facts, rather to show how this great quantity of candy is produced.

Like most of our modern industries candy-making has been greatly affected in recent years by the introduction of labor-saving methods and modern machinery. The most expensive candies, those which retail at two dollars a pound and upwards, are still made almost entirely by hand. They are cooked in small batches and in general follow the same sort of technique that sister uses in making fudge on the kitchen range. The output, it is true, may reach several tons a day, but this is accomplished by the addition of workers.

The next grade of candies, those retailing at from a dollar to two dollars a pound are also cooked in small batches, usually in kettles of about fifty pounds capacity. It is claimed by the makers that greater uniformity and better flavoring are thus secured. If a kettle full of candy is spoiled in the making it can be thrown away without much loss, whereas if larger quantities are made, the candy has to be "doctored up" and passed on to the consumer, who never suspects the trick.

In making the cheaper grades of candies, the bulk chocolates and the "hard tack" of school days, great kettles of as much as a thousand pounds capacity are used and machinery largely replaces hand labor in the production process.

Most candy manufacturers buy their chocolate in fifty pound bars from chocolate manufacturers. But some of the makers of fine candies buy the cocoa bean, roast and grind it, and add their own ingredients. It adds to the cost of the candy to make the chocolate in such small quantities, but the blend is "just right."

As the quality of candy goes up the proportion of nuts and fruits used increases. One manufacturer of an expensive brand of candy uses 35,000 pounds of nuts a year. And these must be whole nuts. The broken ones are used for cheaper grades. Likewise, in the most expensive candies only perfect fruit in large pieces is used and this is simply chocolate coated. In the next grade the small pieces of fruit are used and these are packed in a sugar filling and then chocolate coated. In the expensive candies pure fruit flavors are used and in the cheapest artificial flavors are sometimes employed.

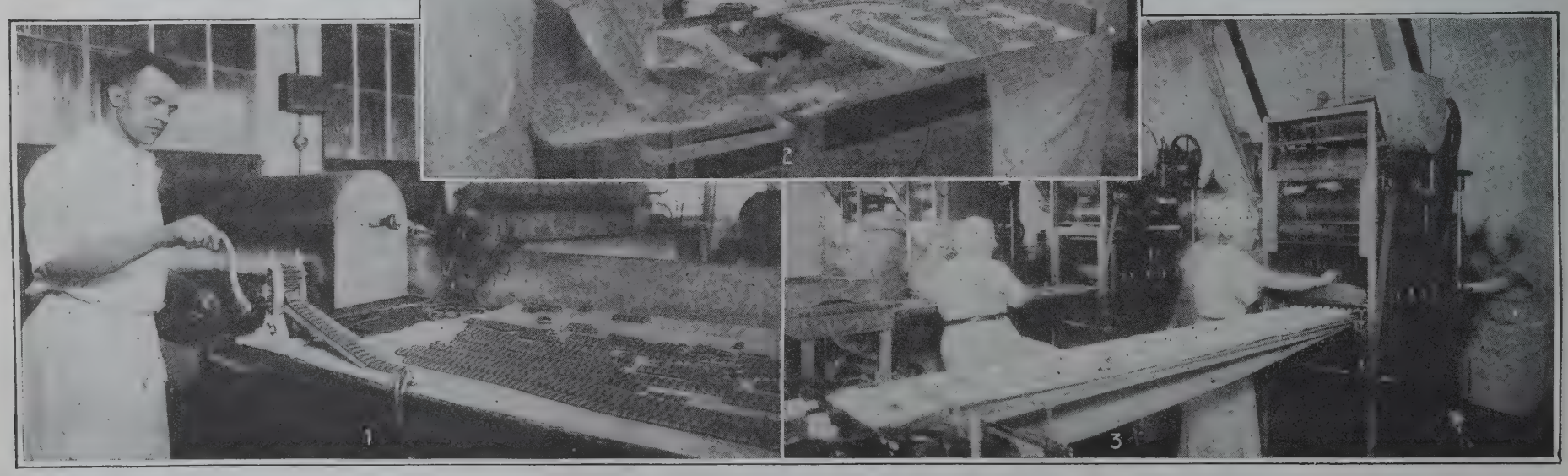
A recent development in the candy business is the great increase in the sale of "unit goods," the tinfoil wrapped pieces that are for sale everywhere at from five to twenty-five cents a package. This has been brought about by the almost total disappearance of "penny goods," due to high prices. The child who once would have been given a penny for candy, now gets a nickel and he usually has to go back after another penny before he can buy anything. The candy makers have invented the "unit package" to satisfy this kind of trade and to tempt the man or woman who just wants something to "nibble at" while waiting for the train or a street car, in the park, or at the corner grocery store.

Perhaps the most striking feature about a big candy factory to the casual observer is the fewness of the big copper cooking kettles or vats. Only a few of these are required to cook the candy for a very large factory and they occupy only a small fraction of the floor space.

Usually the factory is divided into two or three departments, according to the nature of the products. One makes nothing but chocolate-covered candies, another bon-bons and a third "hard candies."

In the chocolate department the most important machine is the "fondant" machine. It makes the fondant or creamy filling that is the base of nearly all chocolates. The fondant, as every home candy-maker knows, is simply sugar and water, cooked to the consistency of very

(*Continued on page 94*)



All photos on page copyright, Keystone View Co.

1. Cutting hard candy and spreading it to dry in the breeze from the fan. 2. Converting slabs of nougat first into strips and then into squares. 3. The machine for dipping popular priced chocolates

**How modern candies are made on the factory system**

### Handling the Reinforcing for Concrete Piles

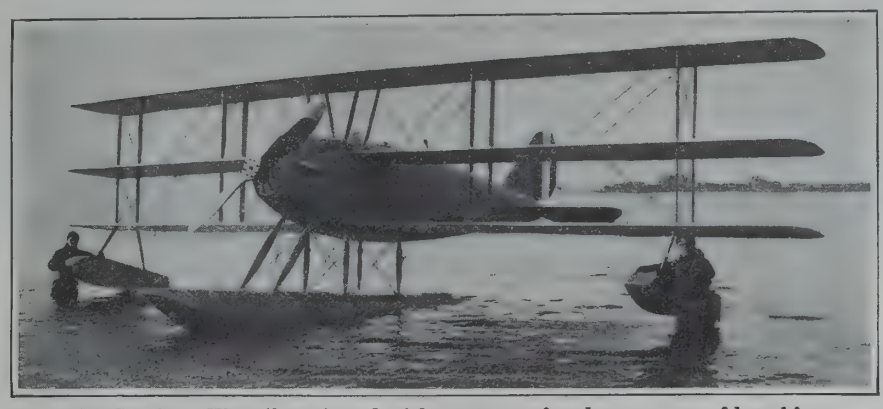
THE accompanying view shows the method of handling the reinforcing in very long piles, as used along the San Francisco waterfront. The reinforcing is assembled on five supports. When ready to be placed in position in the forms, three wooden horses are placed in position. There is a chain hoist on each of the horses, and the hoists are attached to the reinforcing, the reinforcing is raised clear of the supports and then moved to the right to a point directly over the wooden form, and then lowered into position in the form. A one-inch piece of wood is placed under the legs of the horses, so as to tip the horses slightly in the direction in which the reinforcing is to be moved.

Wooden forms and the supports for handling the reinforcing used in concrete piles

### The Fastest in Hydro-Airplanes

THE Curtiss "Wasp," equipped with pontoons, recently established what is claimed to be a new world's record in the Navy trials held at Rockaway, L. I., by traveling at the rate of 138 miles per hour. The 'plane, which is shown in the accompanying illustration, was piloted by Roland Rohlfs, the well-known Curtiss test pilot, and is the same machine in which he established new world's records for altitude and climb at Roosevelt Field last September.

The machine is now the property of the U. S. Navy and will be used at Hampton Roads, Va., for training purposes. The former world's hydro-airplane record was 126 miles per hour, held by the Curtiss HA hydro-airplane. The equipment of the Curtiss "Wasp" is a Curtiss 12-cylinder 400-horse-power engine.

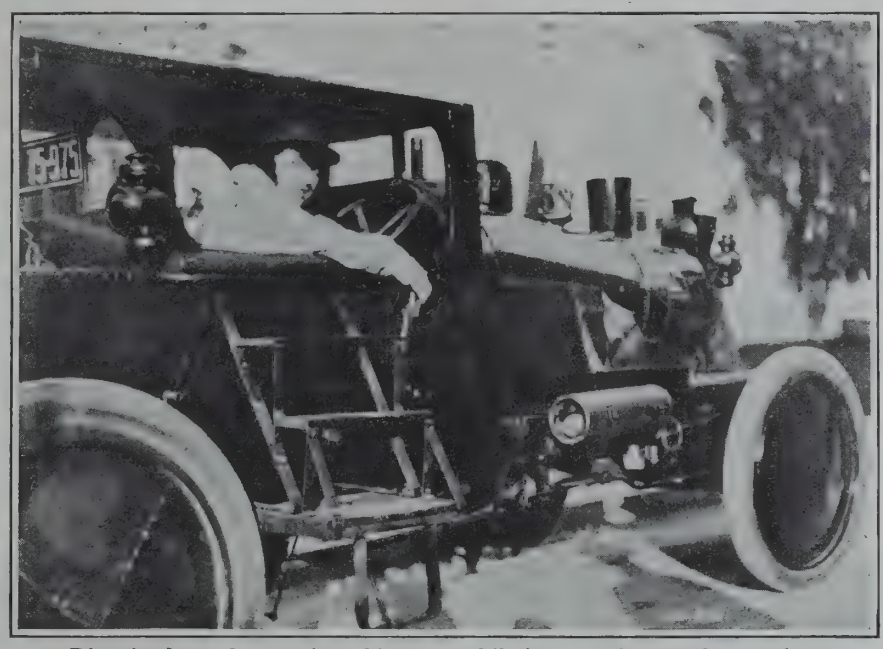


The Curtiss "Wasp" equipped with pontoons for the purpose of breaking the world's hydro-airplane speed records

### When a Locomotive Is an Automobile

CERTAIN progressive Californians have gone ahead with novel automobile designs. In fact, while most of us have been contented with such slight modifications as straight-lined bodies or angular mudguards, these Californians have come forth with the road locomotive, which is nothing more than a camouflaged automobile.

As a novelty, the road locomotive is a great success. It goes along the road at any speed, with clanging bell and a shrieky whistle. It undoubtedly gives a new twist or thrill to motoring. Otherwise it has no definite advantages over the usual motor car; if anything, it is more cumbersome and certainly less handsome.

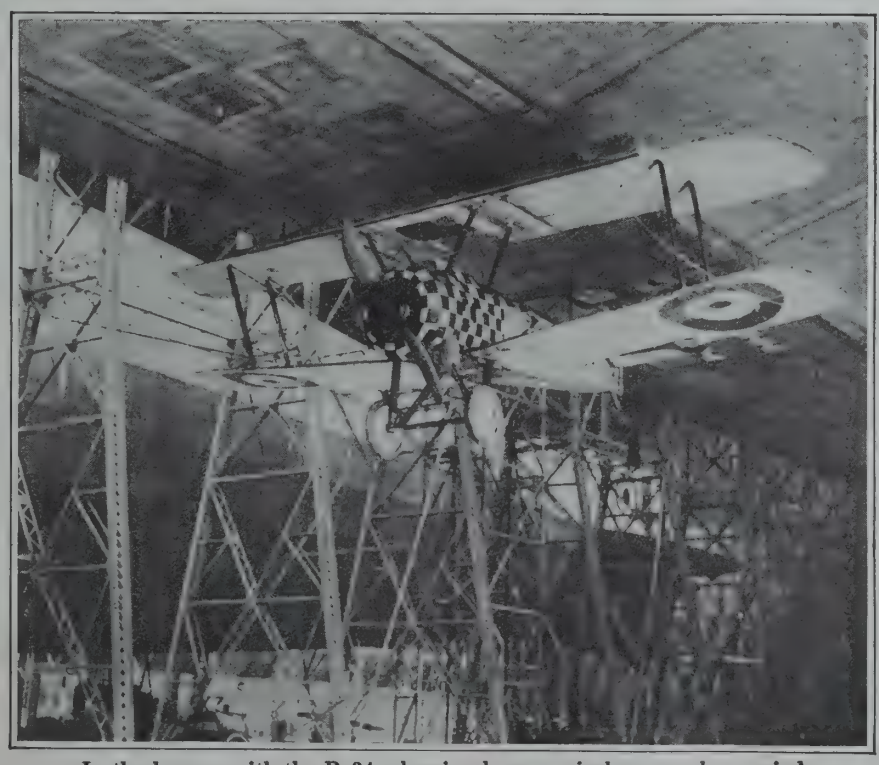


Disguised as a locomotive, this automobile is attracting much attention

### Airships That Carry Airplanes

THE helplessness of dirigibles in the face of airplane attacks may be considered a matter of the remote past. It seems that dirigibles of the near future will carry fast, single-seater fighting airplanes along with them for the purpose of defending themselves against airplane attacks.

The British, who appear to have taken the lead in dirigible construction and operation away from the Germans, have been carrying on extensive experiments with airplanes carried by dirigibles. The accompanying illustration shows the giant airship R-34—the dirigible which crossed the Atlantic last summer—in the hangar at Howden, Yorkshire, England, with an airplane suspended below it. The airplane can be reached by passing through a trap-door and down a swinging ladder to the airplane. At the opportune moment the airplane, with motor going at the proper speed, is released from the dirigible and after a very slight drop goes forth on its own flight. The disadvantage, of course, is that once the plane is launched, it is not possible for it to return to the airship, so that the latter will be as much at the mercy of a second attack from hostile planes as under old conditions it was to a first attack. But even immunity from a first attack is something.



In the hangar with the R-34, showing how an airplane can be carried

### Aerial Fish Patrol

A PEACE-TIME use for government airplanes has been found that may result in greatly enlarging one of the main industries of the coast states. This is the application of the planes to the location of schools of fish at sea and reporting the discovery by wireless to the canneries.

This new use for airplanes or seaplanes, as the type used in the work are called, first developed but a few months ago, following experiments which were being carried on from the North Island Naval Air Station at San Diego, California. Aviators had commented on numerous occasions upon the ease with which they could discern objects, animate and inanimate, in the depths of the sea.

It was on December 17th that the aerial fish patrol was officially organized at that station and the discovery of schools of sardines was radioed from the planes to the air station, whence word was quickly sent to the fishing fleets in the harbor, with the result that the first four boats to reach the area designated brought in, respectively, 1,165, 4,700, 19,200 and 3,245 pounds of the fish.

A few days later three fishing boats brought in a total of forty tons of sardines, and the success of the venture has continued every day since on which the planes have made their patrol flights.

The ocean in the vicinity of San Diego has been divided into sixty mile squares, as shown upon charts, and each of these squares is divided into ten mile squares. Upon the charts, which are furnished to all the naval air forces operating and to the fishing industries, the larger squares are given designated numbers, and so also are the smaller squares.

When a seaplane, flying at an altitude of some five hundred feet, passes over a patch of water which shows riffles, indicating the presence of a school of fish, the plane drops down closer to the water, where the observer can distinguish the variety of fish below him. If they prove to be sardines, the information is immediately sent by wireless to a subchaser which is usually stationed in the area to be patroled. If the fishing fleets are in the vicinity, awaiting the news, they are advised by means of a megaphone, the number of the large square being given first, followed by the number of the smaller square, with a third number designating the exact spot where the school has been seen. The sub-chaser also radios the information to the mainland, to the State Fish and Game Commissioner, who then advises all of the local fishing industries, the total lapsed time from the discovery until all have been informed seldom exceeding five minutes.

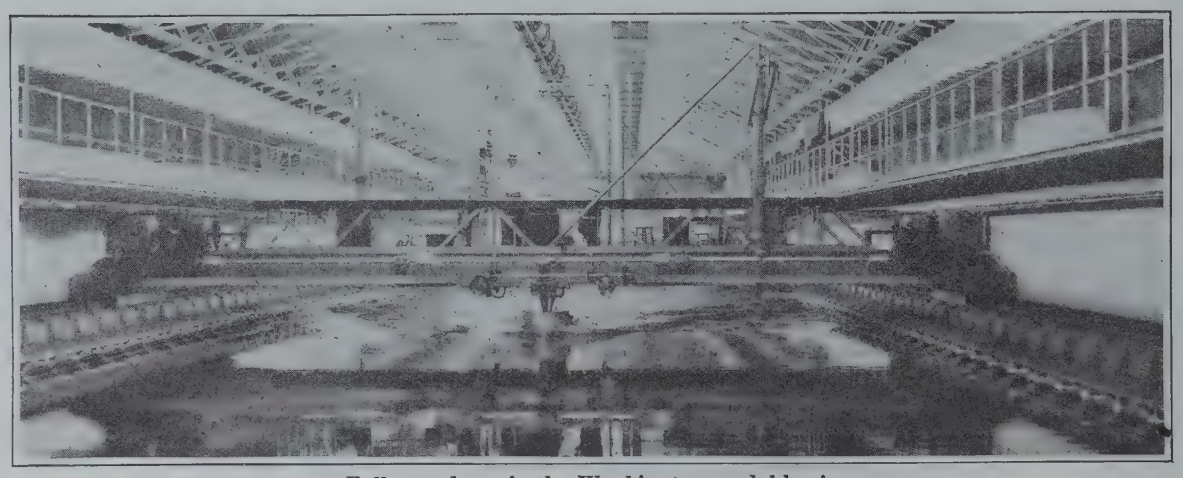
Until the inauguration of the aerial patrol, the fishermen started out with their fleets in the hope of locating schools of fish, but often had to return, disappointed and without a catch, but now the uncertainty has been succeeded by absolute assurance of a successful trip. Canneries which had been idle for some months, for lack of material, have since been running full time, and the canners are feeling more optimistic than ever before. Since genuine sardines are found only in Californian and southern European waters, the impetus which is now being given to the industry in California, through the aid of the government, bids fair to result in making that section the sardine canning center of the world.

As other fish, of the larger varieties, such as yellowtail, tuna, albacore and amberfish, begin to run, generally from early spring until late in autumn, it is anticipated by the canners that the seaplanes will continue to prove of great value, and that the average annual pack of these larger fish amounting to $2,000,000 in round numbers, will be increased to several times that figure.

# Going to Sea in a Tank

## Self-Propelled Models That Make for Better Ships and Less Fuel Consumption

By Robert G. Skerrett



Full-speed run in the Washington model basin

IT should be perfectly clear that the vessel which makes the best speed with the smallest fuel consumption is the vessel whose hull and propellers have the most advantageous shapes. It should be equally clear that in such a complicated matter as the shaping of these members, no general formula can ever be derived covering all the ground. The relation of displacement to resistance, of length and beam and other features, may be expressed in general terms. But the "shape of the hull" and the "shape of the propeller" are such complicated matters that we may be quite certain no formula can ever cover all their many ramifications. If we want to see how a certain shaped hull and a certain shaped propeller will behave, we must try it and see.

Obviously we cannot try it on the full-size, completed ship. A disappointing performance would be too costly. So we have the marine model, and the model-testing basin, and for many years we have had these. The practise has been to construct either wooden or paraffin models of comparatively miniature dimensions, corresponding in hull form to the lines of a contemplated full-size ship. The model is then towed beneath a carriage spanning the experimental basin and so attached to a dynamometer mechanism as to record in pounds and ounces the "pull" needful to move the miniature through the water at a speed mathematically proportioned to that of the proposed ocean-going craft.

Without going into details of a technical nature, it should be plain that the towing of an otherwise passive model can furnish data for the solution of only a part of the problem with which the naval architect and the marine engineer must contend. The dynamometer registers the total resistance to be overcome by the model in its progress through the water. This resistance is composed broadly of two dominating factors: first, skin friction set up between the water and the wetted surface of the hull, and second, the force expended in the creation of waves. Of the minor resistances, that of eddy making and certain reactions induced by the propeller are the most noteworthy. By towing independently of the model a thin plate of suitable length and area, representing the surface but not the form of the miniature's underbody, the skin-friction factor is obtained separately, and when this is deducted from the resistance of the model as a whole the remainder is the sum of wave and eddy resistances.

Until within the past three years this was as far as the model basin went in establishing the requirements of propulsive power for any given ship form. Incidentally, the model trials served to indicate the lines upon which the model should be modified to travel with less resistance and, therefore, with a reduced measure of horse-power. But this procedure left a considerable gap in the sequence of desired information. Even though the practise was to place a small propeller in position, subsequently, at the stern of the model, where it could revolve freely during towing, this test gave a very incomplete index of the real relation between the screw and the craft. The marine engineer had to resort to empirical formulæ to approximate the size of the motive plant he would have to build to furnish in actual horse-power enough energy to overcome frictional losses in the machinery, etc., so as to deliver against the water by means of the propeller or propellers the prescribed thrust in the form of effective horse-power. At the same time, he could not choose precisely the design of screw best fitted to translate the engine's drive into efficient effort upon the enveloping fluid.

The experts realized that they could go forward much more confidently in predetermining what a full-size vessel would do if her model could be tested both by towing and by self-propulsion. In the latter case it would be possible, with suitable apparatus, to choose the type of propeller best adapted to meet the needs of the particular ship form and speed and at the same time to learn to what extent the efficiency of the screw might be affected by the shape of the neighboring stern. Finally, a self-propelled model would lead to a definite figure covering the actual engine power essential to overcoming the external resistances called into being by the craft when underway.

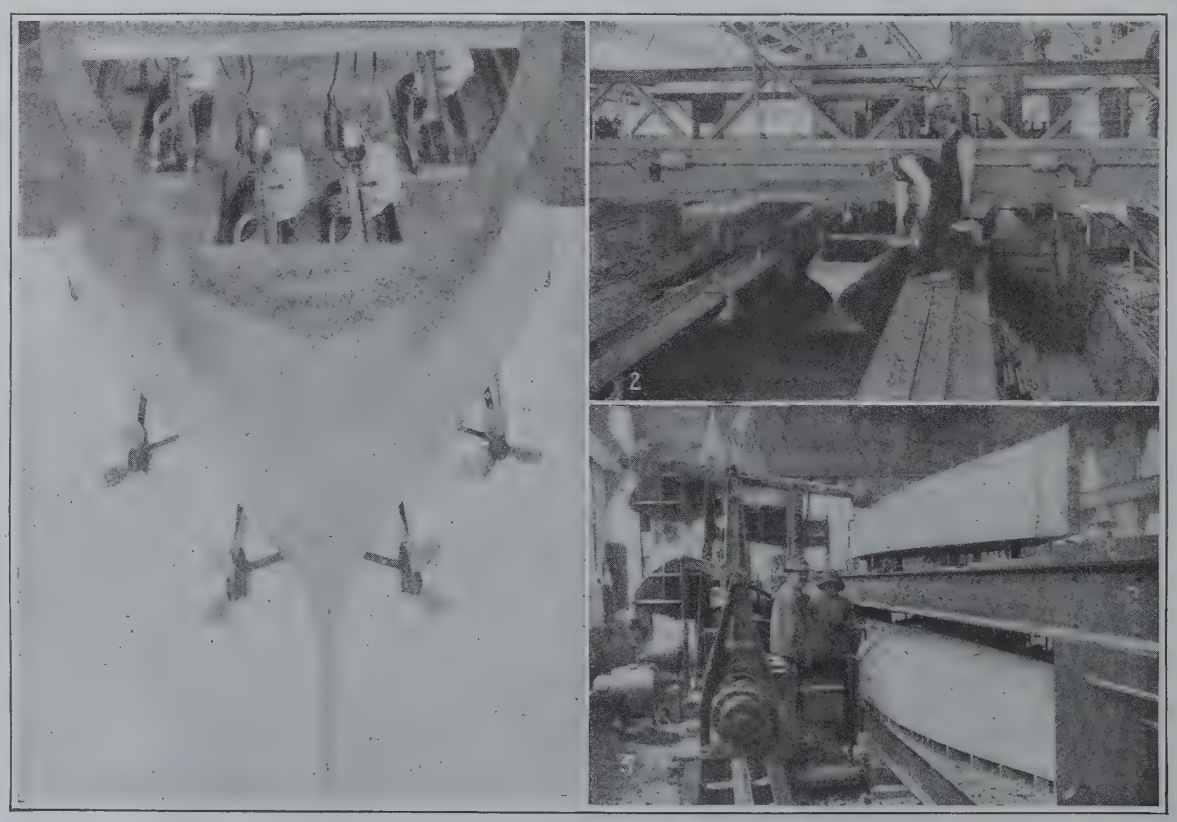
The first experiments along these lines were carried out at the United States Model Basin in Washington in 1918 in connection with designs for single-screw ships. They have since been amplified and used in the testing of models for vessels to be equipped with quadruple screws, such as our gigantic battle-cruisers and our big scout cruisers—not to mention very large transatlantic liners. This research work has been made practicable, thanks to the adaptability of the electric motor and to the facility with which operating current can be measured to a nicety. But before describing the propelling equipment, it might be well to make plain some of the underlying phenomena that bear directly upon the action of the propeller insofar as it tends to increase the water's resistance to a craft's onward motion.

When advancing at considerable speed, a hull encounters resistance which manifests itself in the shape of a bow wave of more or less marked magnitude. A certain expression of this disturbance sweeps sternward, and in a well-designed ship this wave brings its crest just under the counter of the stern section—sweeping in against the vessel's body on both sides, thus inducing a squeezing action that forces her ahead. In this way, the wave of replacement as it is called, offsets the initial check caused by the opposing impulse of the bow wave. The form of the stern may be such as to emphasize or to lessen the helpful effect of the wave of replacement; and the agitation of the water occasioned by the propeller may further impair the beneficial work of the wave of replacement. It can be easily grasped that the churning screws set up, in addition to their greatly agitated eddying wakes, a rush of water toward them from ahead. Clearly, the hull must go forward against this; and with propellers translating a large block of horse-power into drive it is not difficult to grasp the fact that the reactions induced must be of considerable amplitude.

In single-screw models the model is driven by a small direct-current motor connected by means of a flexible coupling to the propeller shaft. The motor's armature shaft, however, is free to move in its bearings, fore and aft, for a distance of 7/16 of an inch, and by this motion to compress a nicely calibrated spring—this action being duly registered upon a revolving drum carrying a strip of paper. In this way, measurements of thrust are recorded in pounds and fractions thereof. Again, the frame of the motor is mounted so as to rotate in independent bearings, and, by another calibrated spring, the tendency of the frame to rotate can be read also in pounds—this figure indicating the torque. Other mechanisms give the factors of time, number of revolutions, the amount of electrical energy consumed, and the speed of the model. Where two, three or four propeller shafts are installed each one is equipped in the manner just described.

During self-propelled runs the miniature ship is not attached to the towing carriage, but is held by it to a straight course through the medium of vertical guide plates 10 inches wide with the edges set fore and aft, which move freely between flanking pins projecting downward from the under side of the carriage. The model can travel independently of the carriage for a longitudinal distance

(Continued on page 95)

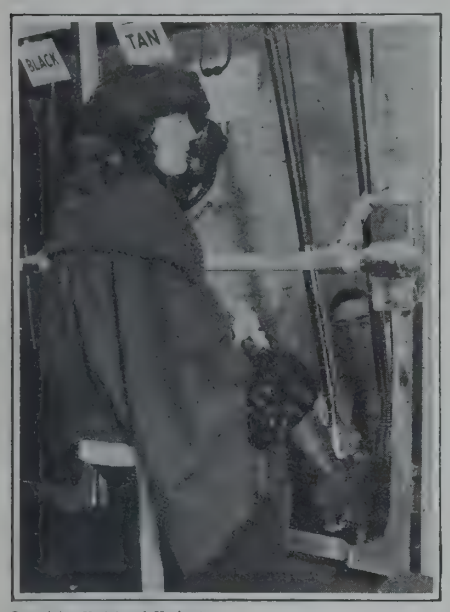


1. Looking into a self-propelled model; note the driving motors and the recording cylinders of the dynamometers. 2. Loading a model with bags of shot, before a test, in order to get the desired displacement. 3. The machine that roughs out the experimental models, working on the pantograph principle.

**Experimental model ships that propel themselves; how they are made and sailed**

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*




Copyright, Kadel and Herbert

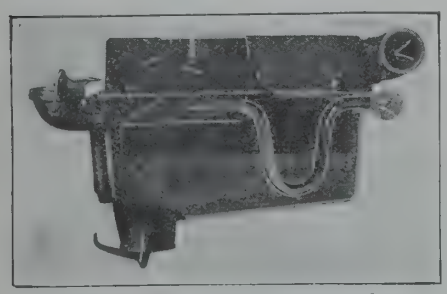
**Shining shoes by electricity**

## The Electrical Shoe-Shine

ELECTRICITY, operating through the medium of the vacuum cleaner and the clothes-washing machine, threatens to put out of business the old-fashioned household worker so far as the matter of supplying elbow grease is concerned. Now the busy little motor is making gestures that indicate a desire to make an end to the business of polishing shoes by force of arm. An enterprising boot-black of 42nd Street, New York, has installed an electric machine that does this, and does it well. So we may expect that eventually the chap who smears blacking on his hands for the purpose of getting the proper fine finish on the shoes of his customers will do so no more, but will be able to carry to work and home again the most elegantly manicured of snow-white digits, if his fancy runs in that direction. As to the machine itself, its construction and mode of action are sufficiently obvious from the photograph and the statement of what it is designed to do. We already have electric buffers and polishers, so it is no great departure to extend their operation to the matter of buffing and polishing shoes.

## Air-Washer for Tractor Engines

A NEW device that is somewhat similar in its action to a carburetor is designed particularly for tractor engines as tractors must of necessity work amidst clouds of abrasive particles. The device washes the air by drawing it into the air-washer through a tube and a partial vacuum is created at the lower point of the tube due to its U shape. Water enters the tube at this point in the form of a spray and commingles with the air. The tube is comparatively thin and wide, so that the air currents are subject to the water spray. This mixture leaving the tube is forced to impinge against a plate and as the velocity of the air at this point is rather low, part of the water drops down from this plate through the air stream thus again bringing the air and water into contact. The air then passes upward to the upper separating chamber where, by means of reduction of velocity and baffle plates which are placed there, moisture is deposited and the air passes to the carburetor. The water together with dust particles drops back to the lower chamber. The air-washer is connected to the motor.—By *B. F. Mundorff.*



**Washing the air that goes to the carburetor**

## A Four-in-One Trouble Locater

IT is well recognized that most of the time required to locate grounds, shorts and crosses in electrical wiring, motors, generators and appliances by the present crude and wasteful methods is consumed in cutting, disconnecting, reconnecting, splicing, soldering, taping and tagging the wires and leads.

In order to save the repairman practically all of this waste of time and labor, and at the same time supply him with several other indispensable instruments, there has been developed the combination instrument here illustrated.

With it the inventor claims that grounds, shorts and crosses in wiring can be quickly and accurately located without cutting or disconnecting a single wire; and in a motor or dynamo the instrument will show whether the fault is in the terminal-block, the brush-holders, the commutator, the armature coils, or the field coils; also in which commutator segment, on which end of segment, in which field coil, and at which end of coil if near the leads. All this can be done without disturbing a single connection. Grounds inside iron conduit or steel-armored cable can also be located without cutting the wires.

The instrument for this kind of service is used like an exploring-coil when remote from strong magnetic fields, and as an alternating-current galvanometer when near coils or heavy currents.

As an explorer, or current-detector, the instrument is claimed to be considerably more sensitive to small currents of standard lighting frequency than the small commercial and home-made exploring-coils. Furthermore, its indications are visual, and therefore unaffected by noise that would in many cases seriously interfere with the use of a coil.

As an alternating-current galvanometer, the voltage drop in a No. 10 wire with only one ampere flowing can be detected between points less than two inches apart. This is equal to the performance of many millivolt meters.

Additional uses as a detector are to tell alternating-current from direct-current circuits, locating broken-down enclosed arresters, locating idle transformers—due to blown fuses—in multiple or polyphase groups without pulling a fuse and estimating the values of currents too small to be judged by the spark.

As shown in the illustration there are incorporated in the device a four-in-one combination instrument—a polarity indicator that does not have to be connected into the circuit tested; a compass with improved patented features that can be used in any position; a frequency meter with a range equal to a standard instrument; and an alternating current detector.—By *C. W. Eisemann.*

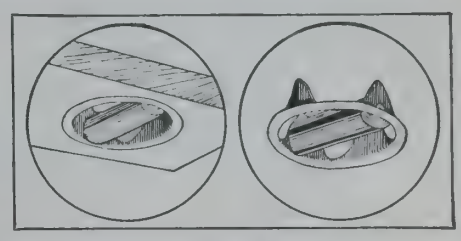
**Front and rear views of an electric explorer that does great work in locating trouble**

## Curious Cardboard Spectacles

SOME very curious optical effects can be secured with cardboard spectacles cut with various openings. The spectacles are easily formed in this way. Disks of cardboard are cut which measure about two inches in diameter. From copper wire a nose piece is bent as can be seen in the diagram. Each end of this is twisted into a hole made at the side of the disk. In the same way the bows for the ears are formed out of wire. One end of each of these is attached to the edge of the cardboard disk and the other is bent round so that the curved part for going over the ear is formed.

The disks of the spectacles are treated in this way. In one pair a hole is driven with a pin right through the center of each. With another horizontal slits are cut almost from one side to the other of the disks. These should be narrow and they may be cut with a sharp chisel or a penknife. In the case of the other spectacles the slit is of the same nature save that it is cut vertically on the disk.

When wearing the various spectacles some remarkable results are secured. Thus the pair with the pinholes restricts the field of vision but makes distant objects stand up with great clearness. It is possible to read print at three or four times the normal distance with the greatest ease. When wearing the spectacles with the horizontal slits it is only possible to see more or less horizontal lines in houses, fences, trees, etc., really plainly. Thus, while the trunk of a tree is difficult to detect, the horizontal branches are much sharper than is normally the case. Exactly the opposite is the case with the spectacles having the vertical openings. Here it is only the more or less upright lines that are really plain. The horizontal lines are very indistinct and if fine disappear altogether. Thus while one can observe the posts supporting the clothes line it is not possible to see the line itself when wearing the spectacles with the vertical slits.—By *S. Leonard Bastin.*



**Roller bearing for heavy furniture, showing attachment and operation**

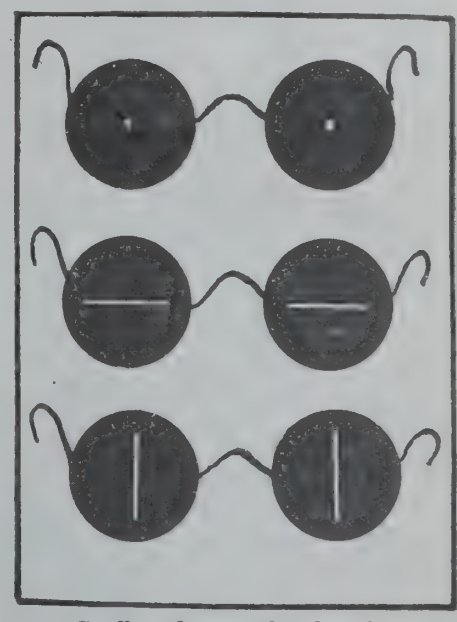
## The Jam-less Drawer

A NEW anti-friction roller for furniture that has sliding parts is a simple steel contrivance with a cylindrical steel roller which sets in a circular frame that fits perfectly into a ⅝-inch auger hole and has a flange that holds the roller 1/16 inch above the surface. The device is designed for use as a bearing for dresser drawers, extension tables, and other articles of furniture that frequently cause trouble and give annoyance because of a tendency to stick.

## Stainless Steel Kitchenware

TO produce a stainless steel that could be comparatively easily worked and could be used in the manufacture of other articles became the task of metallurgists, and after many experiments they discovered the accurate heat treatment at which it became more workable, and the evolution of many new pots and pans has been the result. The production of this steel is being undertaken in large quantities by all the progressive steel makers in Sheffield, and rustless cooking dishes will soon be on the market. These stainless domestic utensils will have a perpetual appearance of burnished steel no matter what usage they are put to. They may be cleaned by simply being washed in boiling water. They will not readily scale like iron, and their bottoms will therefore not get thin.

The new rustless steel will also be invaluable to engineers and can be used for the manufacture of bolt heads and for similar purposes where resistance to the atmosphere is desired. Engineers are even inquiring into its use for structural purposes, such as for bridges, the necessity of painting which entails enormous and continuous expense.



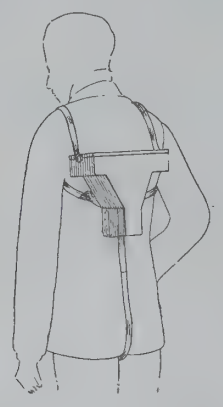
**Cardboard spectacles that give strange results**

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.*

### Pertaining to Aeronautics

LIFE SAVING DEVICE.—J. SEBETO, 553 6th Ave., Brooklyn, N. Y. The invention relates to a parachute attachment to be strapped to aviators and passengers on aircraft for use in an emergency. The general object is to provide an attachment in which a parachute is held in compact form in a container adapted to be



A REAR PERSPECTIVE VIEW OF THE DEVICE AS STRAPPED TO THE USER

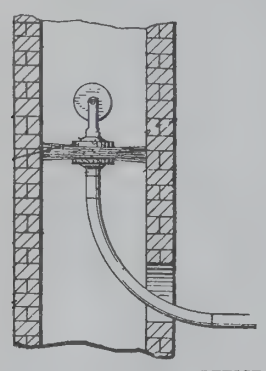
securely strapped to the body of an aviator and in a manner that the parachute may be caused to be automatically and instantly ejected from the container and caused to spread when ejected.

### Electrical Devices

ELECTRIC SWITCH.—W. D. THROOP, 198 Laurel Hill, Norwich, Conn. An object of the invention is to provide a quick acting switch operated by a laterally movable or slide member and which can be utilized for higher currents. A further object is to provide a switch which can be manufactured at an extremely low price, which is strong and durable in use.

### Of General Interest

CONDUIT CLEANER.—E. HALL, 3974 Scott St., Calumet, Mich. The invention has for its object to provide a device of the character specified, adapted for cleaning pipes of any character, as for instance, flues, drains, and the like, wherein a flexible shaft is provided



A SIDE VIEW SHOWING THE DEVICE IN USE

with a circular brush connected to the shaft to rotate therewith, the shaft having a guiding wheel for properly spacing the brush with respect to the flue and for facilitating the insertion and passage of the brush.

### Hardware and Tools

AX.—C. J. KOPRIVA, address A. F. Kopriva, Stony Brook, N. Y. The object of the invention is to provide an ax having an ax head and a removable bit to permit of conveniently and quickly removing a worn out or broken bit from the ax head and to replace such bit with a new one. Another object is to draw the bit securely and accurately into final position on the ax head and to hold the bit in this position against lateral displacement.

### Machines and Mechanical Devices

TYPEWRITING MACHINE.—P. ROBLE, address M. Davilla, 644 Carrera 7a. Bogota, Columbia. Among the objects of the invention are to provide a power-driven machine for automatically and serially printing a group of letters and automatically shifting the lines to be printed, to provide means for augmenting and limiting the marginal width of sheets on which the printing is to be executed, to provide a platen whereon paper is arranged for affording increased facilities for proof reading the printed matter prior to disturbing its relation to the printing mechanism, and to provide means for automatically shifting the line-printing thus avoiding interruption of the manual manipulation of the key board.

### Musical Devices

HOLDER FOR DISK RECORDS.—F. GRAMMICH, 499 Vandervoort Ave., Brooklyn, N. Y. The general object of the invention is to provide a holder formed of rigid material in the form of a case or container and so arranged as to accommodate a reasonable number of records that may be given back support after the manner of an easel to promote the accessibility of the records and their convenient handling.

### Prime Movers and Their Accessories

EXPELLING PIN.—D. J. BELL, 8 Main St., Salamanaca, N. Y. The invention more particularly relates to a tool for removing piston rods from crossheads of an engine. A further object is to provide a substantially heavy pin fitted with an expeller key, which pin may be inserted in the wrist pin bearing of a crosshead and operated to drive the piston rod from its seated position in said crosshead.

### Railways and Their Accessories

AUTOMATIC COUPLING FOR FLUID CONDUCTING PIPES OF RAILWAY CARS.—S. A. ROUSSEAU, De Witt, Ark. The invention relates to couplings in railway cars for fluid-conducting pipes, as for instance, air, water (hot or cold), or steam; the object is to provide mechanism which will connect the pipes when the cars are coupled, and will open the valves which are used to close the pipes when uncoupled, and which when the cars are uncoupled will close the valves to shut off the passage of the fluid.

### Pertaining to Recreation

AMUSEMENT DEVICE.—J. J. STOCK, 81 W. 101st St., New York, N. Y. This invention contemplates the provision of a tub which shall be capable of movement in a forward or rearward direction, rotation in a clockwise or anti-clockwise direction, or pivoting around one point of its circumference or around a diametrically opposite part of its circumference. A further object is the provision of a tub which shall not be in the least dependent upon the action of an outside machine, but which shall be entirely self-contained, even with regard to its supply of current utilized for operating its power plant.

### Pertaining to Vehicles

TIRE FILLER AND TESTER.—C. W. PELTON and J. P. BARBOUR, 215-17 So. Main St., Livingston, Mont. The invention particularly relates to filling and testing automobile tires. An object is to provide a tire air chuck and gage holder combined in one device which when connected with a source of compressed air will deliver the air into the interior of the tire or will cut off the air from the tire and put the latter in communication with the tire gage that the pressure may be readily ascertained; the device is operated by a slight manual movement.

### Designs

DESIGN FOR A BUTTON.—J. R. BELLIS, c/o Searing & Moore Co., 24 Beaver St., New York, N. Y.

DESIGN FOR A MEDAL.—A. de LAUTREPPE and H. M. MESRINES, 101 W. 109th St., New York, N. Y.

DESIGN FOR A POWDER CAN OR SIMILAR RECEPTACLE.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal No. 10, Brooklyn, N. Y.

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## The Last Word in Wireless—The New York Radio Central Station

*(Continued from page 79)*

machine is to be duplicated and installed in the New York Radio Central Station; but this time there will be two 200-kilowatt machines for each transmitting station—ten in all. The achievement, from a radio engineering standpoint, has nothing approaching a parallel: ten alternators, 2,000 kilowatts, 3,000 horse-power—an astounding force to concentrate in realization of a dream to transmit messages over the world to all points of the compass from a single source.

Mr. Nally emphasized another forward step in engineering which will be incorporated in the super-station. "We will utilize what is termed a multiple tuned antenna, which," he explained, "materially reduces the wasteful electrical resistance of the long, low, flat-top aerials formerly used. A great saving in power is thus effected; in fact, for the same power input formerly used for a single station, six times the effectiveness at a distance is obtained. In other words, we obtain with this antenna the same effect at a distance with 200 kilowatts input as would be obtained from the old type of antenna with 1,200 kilowatts input! This new type of antenna is the equivalent of six independent radiators, all operating in unison at the same wave length, and for the complete station with its five antenna units, the power required will be less than 20 per cent of that formerly necessary. The project, however, contemplates additional possibilities. To illustrate: We may, in many cases, utilize but one-half of a single spoke of the antenna system for communication service to a certain point. On this basis, the Long Island Station will ultimately permit simultaneous transmissions to a maximum of ten points in the world, thus doubling the communication facilities originally planned.

"The receiving aerials are of a new type, too; they have been designed for operation with the Weagant system of 'static' elimination, which, by a combination of opposed electrical circuits, nullifies the long-dreaded effects of atmospheric electricity and makes possible uninterrupted reception from foreign countries under all weather conditions. We break away from a precedent once again in locating our receiving units only eighteen miles from the multiplex transmitting equipment instead of following the former practise of establishing one transmitter and one receiver in one locality and restricting the service of the circuit to one overseas destination."

The arrangements for distant control of the New York Radio Central Station follow the same policy of concentration. In Broad Street, the heart of New York's financial district, the company's public telegraph office is being re-equipped to handle the new station's messages along with the Marconigrams which are now received for England, Norway, Hawaii, and Japan. Thus messages for any of the five additional countries reached by the new station will be received in the New York City office and dispatched direct from a series of operators' keys and relays which will operate the powerful transmitting circuits located miles away out on Long Island. Messages from over the ocean will ultimately be received in the same manner, receipt and delivery of the actual messages being effected by the customary messenger boy service direct to the home or office of the user of the trans-oceanic wireless.

It is expected eventually to install apparatus for high speed transmission and reception, which will be under the supervision of a trained staff of operators along with which there will be the usual staff of expert Morse operators who will work those circuits over which high speed transmission is not taking place.

## Descendants of the Water-Wheel

*(Continued from page 82)*

revolutions per minute, it is estimated that the frictional loss will be about 21 horse-power, which is a very moderate percentage of 42,500 horse-power. The shaft, it will be noted, varies in diameter. At the center of the rotor spider, the diameter is 26 inches. At the location of the thrust bearing it diminishes to 18 inches. The flanges which afford the means of uniting the two parts of the shaft into a single piece are 45 inches in diameter. They are, it appears, forged on to the respective shaft lengths.

It might be thought that the provisions for supplying the air necessary to keep the generator cool would not require much attention. But this would be a mistake. Somewhere in the neighborhood of 80,000 cubic feet of air is required to be passed through this generator every minute that it is operating at capacity. Air is obtained from above and also from the pit below. It passes over the windings and through the center core, and is then discharged into the casing which encircles the stator yoke. It then passes into ducts and by means of auxiliary fans is made to discharge itself outside the station. On top and bottom of the rotor steel plate, centrifugal fans are arranged. In addition to the circulating effect thus produced, is the action due to the poles and the ventilating openings between poles in the rotor rim.

What is perhaps the most powerful high-head, inward flow unit in the world is one which has been installed in the White River plant near Sumner, Wash. Its capacity is rated at 25,000 horse-power. The head is 440 feet and capacity speed 360 revolutions per minute. The unit is a horizontal turbine. That is, the shaft is horizontal, and the conduit which pours water from its inner side through the stationary vanes into the rotating device is arranged in a vertical plane. However, the conduit diminishes in diameter as it circles round, just as in the case of a vertical unit. In the present case the runner is of the double type. That is, it is equivalent to two single runners placed back to back and operated as a single unit. There are two points where the water escapes from the double runner—one to the right and the other to the left. This conduit diminishes in diameter as it rises in front and continues on over to the back. By this arrangement of the conduit, the greater amount of water passes under the runner and the lesser amount over it. Gravitation is thus opposed to good advantage.

While this unit is fairly large, it is by no means so big as the one we have been considering, even comparatively. The horse-power capacity of the horizontal unit is only 23 per cent less than that of the vertical one. It is the high head which enables a big output of power to be realized with a moderate-sized, compact unit.

The problem presented by the conditions of conservation at the White River plant required that the heavy fluctuations in the electric load should be responded to effectively by the water-power system. In short, the water supply giving the high head was adequate to high productiveness of current only in case it was wisely used. The White River supplies the operating water. It derives its supply largely from one of the glaciers on Mt. Rainier. The water after being dammed is led through a heavy wooden flume into a forebay, where it drops its glacial silt. The deposits of silt in the forebay are got rid of by flushing and draining. From the forebay the water is conducted to the reservoir at Lake Tapps. This consists of a natural lake whose water level has been raised some 35 feet. Deepened and enlarged, the lake has a storage capacity of some 2,250,000,000 cubic feet.

*(Continued on page 94)*

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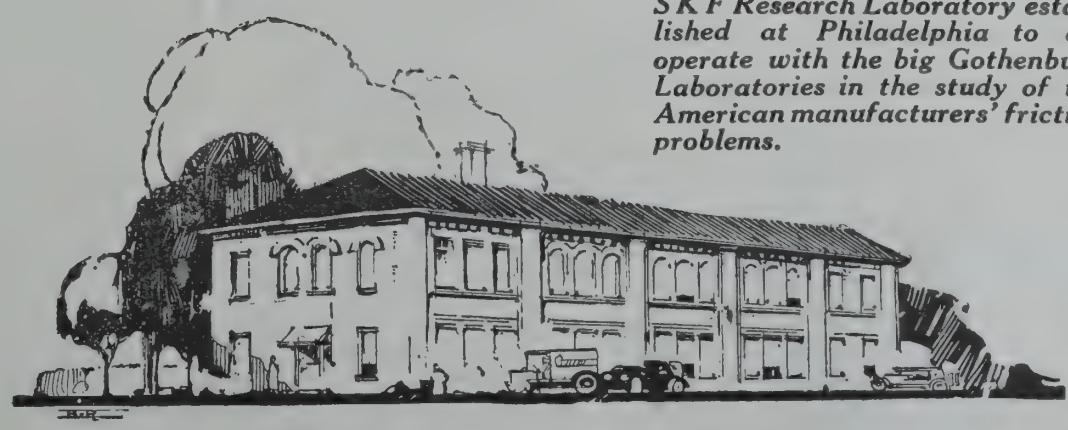

*S K F Research Laboratory established at Philadelphia to cooperate with the big Gothenburg Laboratories in the study of the American manufacturers' friction problems.*

617

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## Descendants of the Water-Wheel

(*Continued from page 92*)

As this is at an effective elevation of 440 feet above the power plant, it is estimated to represent in electric current about 18,000,000 kilowatt-hours. The water is brought down from Lake Tapps part of the way through a deep open cut and a 3,000-foot tunnel. The cross-section of this tunnel is such as to pass water at the rate of 3,000 second-feet. From the forebay at the lower end of the tunnel, steel pipe-lines carry the water down to the power house. These pipe lines are each about half a mile long and 8 feet in diameter. Sudden changes of the flow of the water through the tunnel and the pipe lines, particularly the latter, might be expected to develop violent variations in the pressures exerted from within outward. Some of the devices employed to meet the requirements are as follows. A surge reservoir was provided at the lower end of the tunnel to prevent surges, due to the tunnel, from causing violent effects in the pipe lines, etc. Then pressure regulators were installed in connection with the turbines of such sort that they release water suddenly when the governor abruptly closes the gates which admit water to the turbines. In order to make the plant responsive to sudden demands for power, air-cushion tanks have been installed. These react quickly upon demand, though naturally they can last for only a short time.

## Fifteen Thousand Photographs per Second

(*Continued from page 83*)

tures, one centimeter high, are received on the film, each picture will pose 1/5,000 of a second. Five millimeter views will pose 1/10,000 of a second, and so on. At that speed, the action of daylight is negligible.

We have already seen that M. Bull's installation gives a photographic field of 40 centimeters, same being the width of the luminous pencil. At the initial speed of 200 meters per second, a projectile passes through it in 1/500 of a second and by photographing same each 5/1,000 of a second, ten views can be obtained. It is absolutely necessary that all the various parts of the system work very closely together. As it would be useless to expect an absolute simultaneous action, the shutter must be opened and the series of sparks begun before the moment when the projectile enters in the luminous pencil. The interval should be reduced to the minimum, however, for two reasons: To avoid daylight touching the film for any length of time; and in order not to waste uselessly the loaded condenser which supplies a limited number of sparks, and on the other hand, to prevent the film, which continues to revolve, from being impressed a second time, which would blur the picture. It is therefore necessary to stop the sparks and shut the shutter as soon as the projectile has crossed the photographic field.

These various conditions are attained by means of electric control. The tumbler (or sear) which moves the striking lock of the cannon puts on a contact which opens the shutter during the inflaming of the powder. Another contact, which is caused by the "kick" of the gun, closes the circuit which unites the condenser to the exploding device and the sparks begin immediately. The motor is put in motion at about the same time as the shutter opens.

On a wooden frame placed in the firing axis, several centimeters outside the field, two threads (or wires) are stretched. These threads are cut by the projectile and one of them stops the sparks while the other closes the shutter.

With the electric device we have just described, M. Abraham has obtained 80,000 sparks per second and M. Bull might be able to obtain photographs at that speed, provided the film would move with the required speed. The posing period of each element of the film would always be the same since it corresponds to the time the spark lasts. It is impossible to foresee whether this enormous speed can be used in practice, but it seems probable that M. Bull will not find too many difficulties to exceed largely the rate of 15,000 photographs per second.

## Some Observations on Eggs

(*Continued from page 85*)

field, was flooded out during an early June irrigation. There were six eggs in the nest, which the farm children replaced as soon as the water was absorbed. They hoped that the meadow lark would return to the nest.

But the mother bird didn't. After a few excited outcries, as she discovered the irrigation water inundating her, she flew away. The next day the children discovered her building a second nest high and dry on a ditch bank, and a few days later the second nest was supplied with its full complement of eggs.

This meadow lark did what all wild birds do when a nest is robbed or destroyed. In the egg organs of the bird during the hatching season are a large number of undeveloped eggs. The bird ordinarily lays only the regular clutch, one egg to twenty, varying with different birds. However, if a nest is robbed or destroyed, the female bird will immediately proceed to produce more eggs to supply the deficiency. The possibilities in this unnatural stimulation are somewhat undetermined among wild birds, but that the egg-laying faculty is much greater than is generally supposed some authenticated instances show. There is the substantiated case of a flicker, one of the larger woodpeckers, a variety which ordinarily lays a small clutch. The nest of this bird was systematically robbed from day to day, and thus stimulated the female produced 71 eggs in 73 days.

In the light of this faculty, possessed by all wild birds, it is easy to comprehend how the domestic fowl was developed into the great egg layer she now is. Originally, it is fair to presume, wild chickens were simply confined, and their eggs regularly removed. In the course of centuries, as this treatment was continued, egg-laying became more and more a fixed characteristic. In most breeds, poultrykeepers still have to contend with broodiness, a desire to hatch out eggs, which seizes the hen several times in the course of the year. When the hen becomes broody, poultrykeepers "break her up," and if she is a good layer she is soon producing eggs again.

Development of egg-laying in the lightweight breeds, particularly the White Leghorn, has resulted in the practical elimination of broodiness. With the average White Leghorn flock, hatching can only efficiently be accomplished by using broody hens of other breeds or an incubator. It is not practical to attempt to hatch eggs with a young white Leghorn. Few become broody, and those which do are very uncertain setters.

Potentially all our wild birds are egg-layers. In taking the chicken and developing it into the egg machine it now is, mankind probably used the wild bird best adapted to the purpose—which goes further to show that even the farmer's scientific "hunches" are apt to be correct.

## Uncle Samuel's Sweet Tooth

(*Continued from page 88*)

thick molasses and beaten until it becomes the creamy filling with which we are all familiar. The sugar and water are cooked in a big kettle and then drawn up into a cooling tank by vacuum. The stuff then passes through water-cooled pipes and drips to a motor-driven beater, which delivers the fondant to vats mounted on hand trucks.


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All good amateur candy makers know that flavoring should be added after the cooking and this is done here. The fondant is taken to steam-heated tables, which keep it soft, and flavoring, nuts and the like are added and the mixture "kneaded" into the candy by the workman. The fondant is then shaped, either by machinery or by hand, according to the quality, and is dipped in chocolate. If the dipping is to be done by hand the fondant passes to girls, each of whom has a puddle of soft chocolate at her side, which she constantly stirs with one hand, while she dips the chocolates with the other. As her hand leaves the finished piece, she draws up a tail of the chocolate and bends it back over the piece, giving the "finish" with which we are all familiar. The chocolates are left to dry on small squares of embossed waxed paper, so that when they are removed the maker's name has been impressed in the bottom.

If the chocolates are to be dipped by machine, girls arrange the fillings on an endless belt, which carries them to the machine. Here they are transferred to a belt of wire rods and are carried through a slow-moving stream of molten chocolate. The excess chocolate drains off through the belt and is carried again to the top of the machine, where it is remixed and again passes through the belt. As the chocolates pass out the other side of the machine, they are again transferred to an endless belt. Two girls seated at this side of the machine dip their fingers in chocolate and add the "finish" of hand-made chocolates. The belt carries the candies through a slot in the wall to the next room, where the air is so conditioned that they rapidly dry. Girls remove them from the belt and they are then ready for packing.

Many of the hard candies are molded by a process very similar to that used in a foundry. The molds are made of starch, into which a pattern has been pressed. The candy is run into the molds from vats, which are steam-heated to keep the candy soft.

In making the familiar hard candy "pillows" the candy is molded into long strips, is run through a heater to soften it and then is cut by passing it between the teeth of two especially made gears. Caramel and nougat cubes are produced by making the candy into slabs and cutting it on a machine which has much the appearance of a buzz saw. The "saw" however is a revolving knife.

The machinery of the candy factory also reveals the secret of making "Jordan almonds." The nuts are placed in a revolving drum about the shape and size of a cement mixer. As this revolves the candy is admitted and the nuts gradually become coated evenly with the delicately flavored hard candy.

Each kind of candy really requires special process and machines and a little department all its own, so it will be seen that a very large output is essential to economical manufacture. The troubles of the maker are complicated by the fact that the demand for candy is seasonal. Thus, we buy and eat nearly as much candy during the months of October, November and December as in all the rest of the year. This problem is met by the maker of cheap candies by producing candies of a kind that will keep well and storing them for the busy season. The maker of expensive candies must sell his product quickly, however, because his goods become "stale" and unsalable within a short time. He can only meet the difficulty by hiring many workers in the busy months and reducing his force during the rest of the year.

Present high prices, which might be thought to cause a reduction in the demand for candy, are having the opposite effect, candy makers say. We are consuming more candy today than ever before in history.

## Going to Sea in a Tank

*(Continued from page 90)*

of 3 inches; and this play gives the operator the needful leeway in adjusting the speed of the carriage to that of the model—his object being to keep the guide plates clear of the limiting stops. If the guide plates strike the stops, owing to the model and the carriage getting out of pace, then the run does not count.

A series of runs consists of a score or more trips the length of the tank at increasing speeds; and from the data so obtained are plotted curves showing the torque, the thrust, and the revolutions per minute at the several velocities. All models at Washington are 20 feet in length, and, according to the size and character of the proposed vessel, these miniatures have a dead weight of a ton or more. The single-screw models tried out in 1918 had a maximum displacement of 3,774 pounds.

After the self-propulsion tests are made, it is the custom to remove the propeller, and then the motor or motors are driven so as to get readings of the shaft friction and the amount of thrust in the absence of the screw or screws. The next step consists in attaching the model to the towing carriage, and in establishing, by successive runs, resistance data peculiar to the model and independent of the propeller. It is important that these runs be carried out with the model in the same condition as when self-propelled and, also, that the temperature of the water be substantially identical in both series. It seems that investigators have discovered that resistance may be increased as much as 4 per cent for each lowered 10 degrees of temperature of the water, and lessened by each corresponding rise of 10 degrees.

Facts about the characteristics of different designs of screws are secured by testing them apart from the model by runs in the tank. For this purpose there is a special equipment carrying a projecting propeller shaft well forward of the supporting structure so that the screw actually turns in undisturbed water—moving ahead of the driving apparatus. The result of the present method is, therefore, that the screw and the model can be subjected to examination independently and then tried out in combination.

Much added knowledge has been garnered having to do with the efficiency of the propeller agreeably to the surface condition of its blades; and we know today how the screw is affected by the shape of the model and by the state in which the water arrives within the zone of action of the propeller. All of this mass of information is important and bears directly upon the capability of our new-born merchant marine to hold its own in competition with the ships of other nations. The cost of fuel has reached a point where every pound saved in realizing a given sustained sea-speed is of economic moment; and the self-propelled model is aiding us to determine vital facts about a prospective craft's operative charges. We can build ocean-going freighters confidently and be certain that they will maintain their prescribed speeds when burning less coal or oil than many another rival steamer of similar cargo-carrying capacity.

## Explosives from Sugar

SOME particulars were recently communicated to the German Chemical Society regarding the process developed during the war by the production of explosives from sugar.

Glycerine was produced from the sugar, the former being used as the initial product for trinitro-glycerine. The process, invented by Connstein and Ludecka, is based on the fermentation of sugar. It was already known that sugar, when fermented, produced minute quantities of glycerine. The inventors found that the


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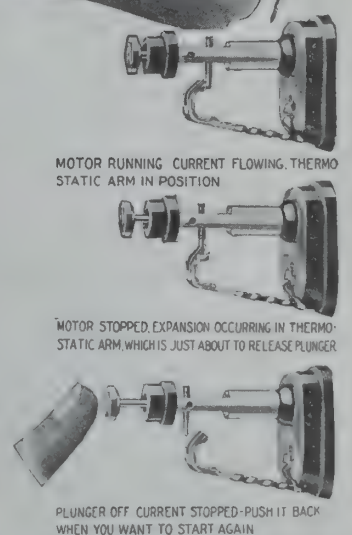

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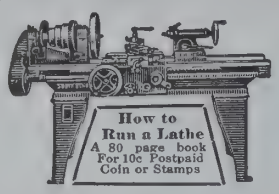


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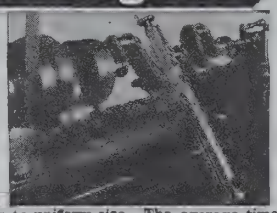

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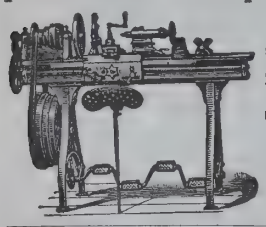

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percentage of glycerine obtained was considerably augmented by adding sodium sulphite to the fermenting bath. To a solution of 1 kilogram sugar in 1 litre of water they added 400 grams of sulphite, 10 per cent of the sugar being allowed to turn into yeast. They then made sure that the yeast cells were properly nourished or propagated. After two days the sugar had completely fermented. By suitably working up the liquid so obtained, a glycerine suitable for all technical purposes was obtained.

The process was organized by a company and carried out by 63 works. After a few difficulties were overcome, it was possible finally, from 100 parts of sugar, to obtain 20 parts of glycerine, together with 27 parts of alcohol and 3 parts of aldehyde. One works produced 1,000 tons. of glycerine a month, the annual consumption of sugar being 70,000 tons..—*Zeitschrift des Vereines deutscher Ingenieure* (Berlin), July 19, 1919.

## Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to Correspondents are printed from time to time and will be mailed on request. Please write your queries; do not telephone them, please.

(14332) N. B. asks: I have your book SCIENTIFIC AMERICAN Cyclopedia of Receipts, etc., published in 1892 and have used same with profit many times. It has now gone back on me. I wish to silver a piece of glass 7"x9" for use as a mirror, the silvering to be on the front of the glass instead of the back in order to get rid of the prismatic effect of reflections as seen in the ordinary mirror. I do not seem to find a formula suitable for this. Can you refer me to one in the book or send me one? A. You will find the Brashear process for silvering glass a most reliable one. It is now employed in silvering the large mirrors in the great telescopes. It is No. 10 on page 502 of the SCIENTIFIC AMERICAN Cyclopedia of Formulas. The Draper process is also reliable but is older than the Brashear process. Everything depends upon perfect cleanliness and most careful attention to every detail, else the work will be spotted and worthless.

(14333) H. R. B. asks: A contends that a vacuum exists and also that vacuum has the power to restrain or act as a nonconductor against such an energy as heat. Is he correct in his contention? A. A vacuum is the best insulator against heat which is attainable. A perfect vacuum would be a complete insulator and would retain or exclude heat indefinitely. The common thermos bottle is an example of the use of a vacuum for keeping liquids either hot or cold. Heat is retained in hot liquids and kept out of cold liquids. A is quite correct in his contention. However there is a difference between heat from a white hot body like the sun or an electric lamp and heat from a liquid or solid such as may be contained in a thermos bottle. The intense heat from a white hot body will pass easily through the best vacuum man can make, as witness the heat given off by an incandescent lamp bulb, which will char and set paper on fire. A vacuum will restrain heat of low intensity but not heat of high intensity.

(14334) S. M. R. asks: Kindly settle a dispute we are having in regard to an article contained in the SCIENTIFIC AMERICAN. "A" maintains that the water pumped from the copper mines if placed in a container and tin placed therein that the tin will be transformed into copper. Please be good enough to state whether it is possible by any method to transform tin or iron into copper. "A" claims that an article containing the above to have appeared in the SCIENTIFIC AMERICAN. A. There is no method known to chemists for changing copper to tin or tin to copper. If a copper deposit is made upon tin from water which has been pumped from a copper mine, it is because the water contains some salt of copper dissolved in it and this is by an electrical action decomposed and the copper is plated upon the tin or iron. This may very easily take place. A knife blade dipped into a solution of copper sulphate will in a few seconds become coated with a deposit of copper for the same reasn.

(14335) B. L. P. asks: During the month of September, 1918, I had the privilege of seeing a most wonderful phenomenon. I was compelled to lie out in the sunshine a certain portion of each day and necessarily wore black glasses. One morning, a day or so after a rainstorm, the sky became partially covered with swiftly moving, thin, fleecy clouds. I was turned toward the sun, but protected from its most direct rays by the corner of the roof. Looking at the clouds near the sun, I was startled to see them turning different colors. Thinking perhaps I was just seeing a rainbow on the clouds, I continued to look carefully. But no, the rainbow colors were there—beautiful, soft pastel shades of pink, green, blue, lavender, yellow, orange—*but they were not in rainbow formation nor did they appear in the same position twice.*

As the wind caught fragments of clouds, they became so many bits of color, weaving in an out, a veritable kaleidoscope of the heavens. There seemed to be no uniformity of color in reference to the position of the sun, except the clouds nearest the sun were usually a sort of apricot color. But the pinks and blues, green and lavenders all mixed together in a marvelous manner. To make sure I did not dream all this or imagine it, I had my mother and sister each lie in the same place and look through the dark glasses. They both saw the same coloring. Since then I have seen the same phenomenon, but always in the morning when the sky was clear except for these fleecy clouds, and always through dark glasses. Having spoken to a number of people about this, none of whom can explain it, I am writing to you, to see if any one else has had the same experience, or can explain the reason for the color separation. A. Your observation of clouds near the sun forming beautiful colors is very interesting. What you saw were bits of halos from the water drops or perhaps ice crystals of the clouds if the clouds were high enough above the earth to be composed of ice crystals. Halos are usually circles of colors like rainbows, but near the sun instead of on the opposite side of the sky from the sun, as a rainbow is. In your case the colors were in the clouds and not in the minute crystals of ice in the open sky. Otherwise the two seem to be similar.

(14336) G. S. DeH. asks: In a discussion with another man, who is of a scientific turn of mind, we came to a standstill in regard to the air pressure below sea level. We know that at sea level it is approximately 14.7 lbs. per sq. in. and we know that as we go up on a mountain top that the air pressure grows less. Now the question is, does air pressure grow less as one gets below sea level or does it get greater and if greater what would be the approximate pressure at the center of the earth, also is gravity strongest at sea level or does it increase as one nears the center of the earth? A. The air pressure increases below sea level in a mine shaft or drill hole down into the earth. At about 1,800 feet above the sea the pressure is one pound less than at sea level. The pressure decreases another pound by about 2,000 feet more of elevation. In an open hole like a mine, a drop of perhaps 1,600 feet below sea level would raise the pressure a pound to 15.7 pounds. The layers of air whose weight is one pound per square inch would become thinner as we descend into the earth. What the air pressure would be at the center of the earth we do not know. Air pressure is simply the weight of air resting on a square inch. On the other hand gravity is greatest at the earth's surface, and diminishes as one goes either above or below the earth's surface. The pressure of the rock and earth strata increases as we descend into the earth, just as the air pressure does, because the weight resting on a surface increases as we descend into the earth.


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# SCIENTIFIC AMERICAN

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INDUSTRY · SCIENCE · INVENTION · MECHANICS

KEEPING THE MOTION PICTURE CAMERA ON AN EVEN KEEL.—[See page 107]

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July 31, 1920

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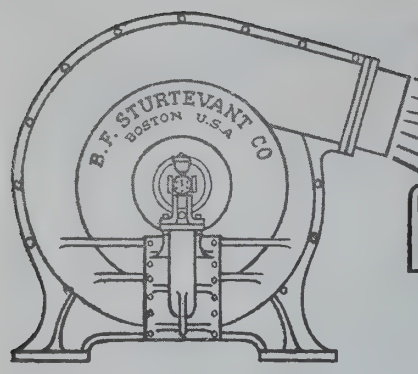


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STEAM and electricity, when harnessed and put to work, will do man's work. They pull heavy trains, those shuttles of commerce that go roaring across the land. They weave into our national life profits and comforts undreamed of a century ago. Truly, steam and electricity are the wonders of the age. But no less wonderful is air, and what air, properly controlled, will do. It will do certain kinds of work more quickly, more efficiently, and more economically than any other known agent. Air will actually pay dividends.

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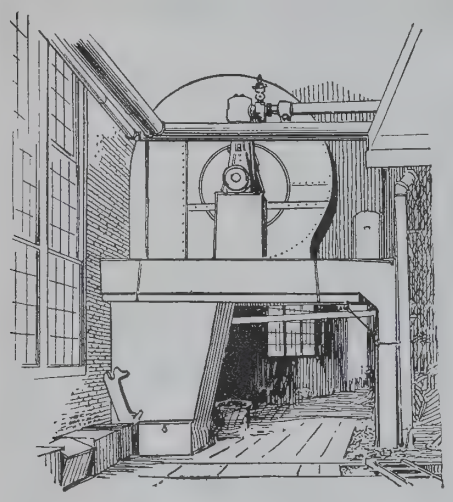
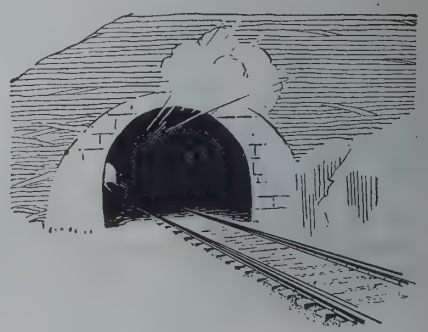
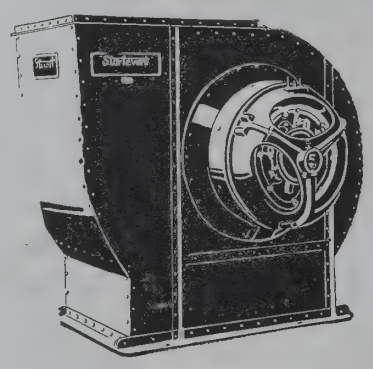
There was a time when ice-coated locomotives were thawed out by heat from steam coils. It took many hours to melt the heavy ice accumulations and to soften the congealed oil and grease. Dense clouds of vapor from the thawing moguls filled the roundhouse. Men could not see to work. Serious accidents were frequent; expensive delays to train schedules were many. An Eastern trunk line installed a Sturtevant Heating and Ventilating System. It solved three problems in this roundhouse—heat, ventilation, moisture absorption. Heated dry air driven by a Sturtevant Fan is carried around in underground ducts and brought into the engine pit. This hot, dry air thaws the ice and quickly carries away the moisture. Today heavily ice-encrusted locomotives can be thawed out in two hours and be on their way to earn dividends for the railroad.



### *How Sturtevant Apparatus Makes Railroad Tunnels Safe*



Positive ventilation of railroad tunnels is absolutely vital. In poorly ventilated tunnels, smoke and gas from the locomotive drift back into coaches and engine cab and often cause loss of life. Engine crews have been known to be asphyxiated by the smoke and poisonous gas fumes from their engines. Sturtevant has installed, in many tunnels throughout this country, highly efficient ventilation systems. By this system an induced draught of air at the portal of the tunnel travels ahead of the entering train. All smoke and gas are carried far ahead of the engine. Thus passengers and engine crew are free from the menace of dangerous gas. If the tunnel is on a grade, the ventilating system is shut off when the train comes down the grade; for there is little smoke and gas when the engine is coasting.



This is only one of the many ways Sturtevant puts air to work.

Your business may be paying dividends. Perhaps it could be made to pay still better if production costs could be lowered. Tell us about your processes. We shall be pleased to send a bulletin covering in detail the particular Sturtevant equipment that can put air to work for you. For three generations Sturtevant has been building apparatus that puts air to work. All the experience, both engineering and manufacturing, is at the command of its engineers. If you wish it, a Sturtevant representative will visit you at your plant. Address

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EUGENE N. FOSS, President

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STURTEVANT ENGINEERING COMPANY, LONDON

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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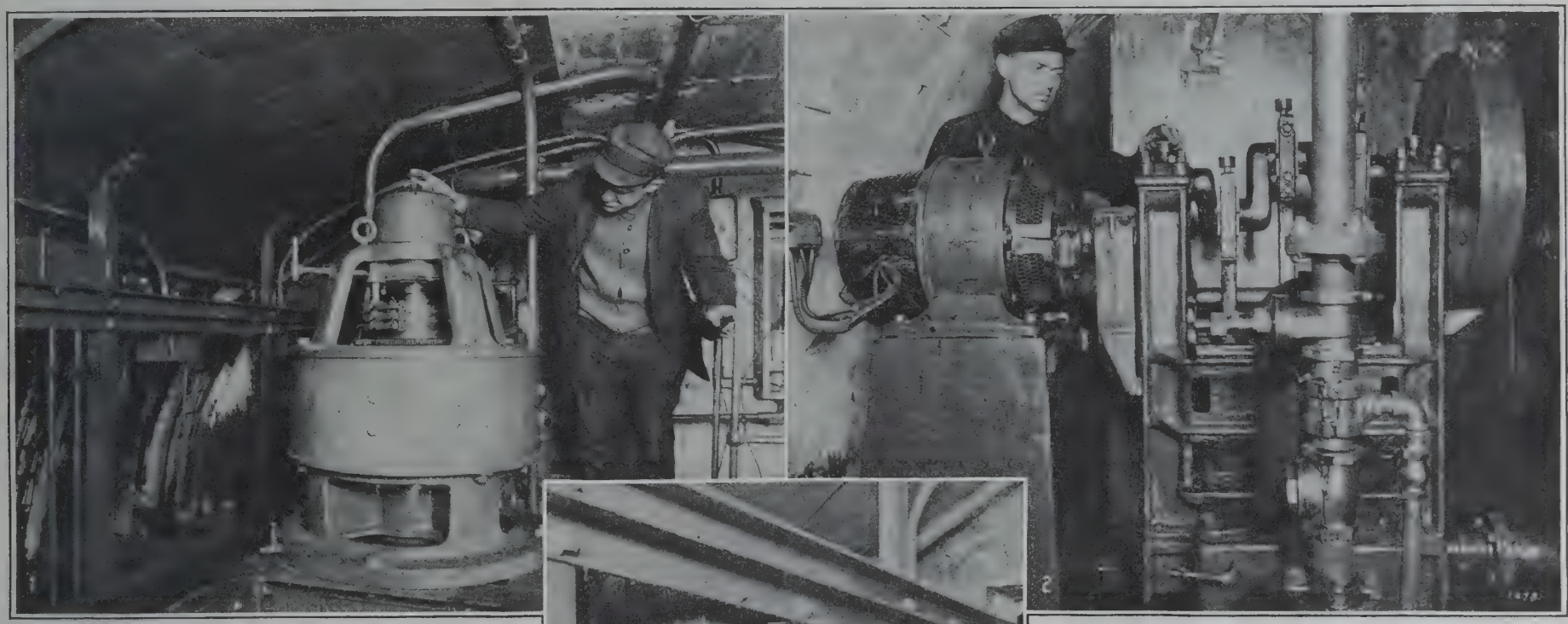

1 The motor that drives the emergency pump. 2. The motor for the pump that handles the ordinary seepage. 3. Sump in which water collects, from which it is automatically pumped

**Part of the outfit that keeps the water down in the Queensboro Tunnel under the East River**

## Keeping the River Tunnel Dry

**By M. A. Henry**

WHAT would happen if one of the walls of the tubes under the Hudson River in New York should spring a leak?

The thought has probably occurred to every person who has passed through one of these great tunnels in a train. And then we promptly forget about it, for nothing of the sort apparently ever happens. But most of us will be surprised to learn that water from the river overhead is constantly seeping in and that scores of automatic sentinels stand guard day and night not alone to insure that this seepage shall be kept under proper control, but as well to guard against the disastrous possibility of an actual break in the tunnel wall which would admit the water in greater volume.

These sentinels are electric pumping stations located at intervals along the tunnels. They are entirely automatic and need only an occasional inspection to ascertain that everything is in working order.

Each pumping station consists of two main units, a small pump for taking care of the water which ordinarily drains into the tunnel, and a larger pump for emergencies. Both pumps are driven by electric motors and are controlled automatically. The water collects in a sump in which there are two float switches, one for each motor, and when the water rises to a predetermined point the float switch for the smaller motor closes. This energizes an automatic contactor which starts the pump. When the water in the sump is brought down to a proper level, the switch opens and stops the pump. But should the smaller pump be unable to handle the flow, the water continues to rise until the larger pump is automatically started through actuation of its float switch.

The photographs show a typical installation in the Queensboro Tubes, under the East River. The smaller motor is of two horse-power and it drives a reciprocating pump with a capacity of 50 gallons per minute. The emergency pump is driven by a 100-horse-power motor. It has a capacity of 1,000 gallons per minute. There are twenty-five such pumping stations in this tube. A noteworthy feature of this installation is that it occupies a floor space only 12 by 15 feet.

## Spontaneous Combustion Temperatures of Liquid Fuels

AN English engineer, named Mr. H. Moore, has recently been making a series of investigations which are of great importance with respect to the functioning of internal combustion motors, since they concern the temperature at which spontaneous ignition occurs in liquid combustibles. The results of these were recently presented by him in London before the Institute of Petroleum Technology.

Mr. Moore defines the temperature of spontaneous ignition as being that at which a substance surrounded by oxygen or air of the same temperature ignites without the aid of a spark or any other local elevation of temperature. To determine this point he has invented an apparatus which has the merits of being simple in structure and rapid and exact in operation. In this apparatus the liquid combustible to be tested is allowed to fall drop by drop into a hole, pierced in a block of heated steel, whose temperature can be controlled and determined with the utmost precision; at the same time there is admitted a current of air or of oxygen which has been previously heated. Mr. Moore has made an extensive study by means of this simple apparatus of varying conditions controlling the ignition points, such as the respective quantities of the combustible and of the oxygen utilized, dilution with carbonic anhydride, and the catalytic action of the metal of the test hole, finding that all these factors have but very slight effect.

The experimenter has formulated tables of the temperature of spontaneous ignition in air and oxygen of a large number of combustible substances, including crude petroleum, various products and residues of distillation, coal tars and distillates, schist oils, alcohol, and purely organic products. By a study of these tables he has been led to the following conclusion:

1. Among the distillation products of petroleum the lightest products possess the highest ignition points.

2. The same rule holds good for coal tar products, but all aromatic products possess ignition points higher than those of the products of the distillation of petroleum at a corresponding point of ebullition. Olefinic products such as the pyrogeneous essences ignite at a lower temperature than the corresponding saturated hydro-carbons.

3. The temperature at which spontaneous ignition takes place in oxygen is generally lower by from 100°C. to 170°C. than the temperature at which ignition occurs in the air.

Mr. Moore has likewise constructed a number of highly interesting curves illustrating the variation of the ignition points according to the proportions of various mixtures of possible substances such as gasoline (petrol) and benzol, and the essence of cannel-coal-creosote and has demonstrated that a small quantity of a component having a low ignition point exerts a very much greater influence than does a large proportion having a higher ignition point.—By *M. Tevis.*

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## How Fast Can a Yacht Sail?

GENERALLY speaking, the speed of yachts is over-rated, and you may safely take from twenty to thirty per cent off when your friend tells you that his craft has done so and so. On the other hand, there are some well authenticated records of high speed made by racing yachts under favorable conditions, which show the best of them to be wonderful examples of the science and craft of shipbuilding. The maximum speed of a yacht, supposing that her model and the cut of her sails are correct, is dependent upon certain adventitious conditions, such as the right kind of wind, the sea, and (above all) the skipper. The ideal conditions for speed are when a yacht is reaching in a smooth sea with the wind over the quarter, that is well abaft the beam, and with everything set that she can carry without an excessive angle of heel.

A well-known authority, Major B. Heckstall-Smith, author of "The Complete Yachtsman," in answer to the question, "How fast can a racing yacht sail?" states that at full speed a racing schooner about 105 feet on the waterline can do about 15.8 knots. This would be in a strong breeze with the wind on the quarter. Assuming that this speed is about right, as he believes, he tells us that with exactly the same breeze, a 90-footer can go 14.2 knots; a 75-footer, 13.4 knots; a 60-footer, 12 knots; a 50-footer, 10.9 knots; a 36-footer, 9 knots; and a 20-foot boat, 7 knots.

Now as to verification of these surprisingly high rates of speed. Beginning with the big fellows, let us take the three-masted American schooner, "Atlantic," which won the Kaiser's Cup in the transatlantic races. The log of the yacht shows that during this race, the famous schooner averaged 14.2 knots for twenty-four hours in mid-Atlantic, and one occasion on Long Island Sound she made an even 16 knots in smooth water and a strong reaching breeze. The Watson, two-masted schooner, "Rainbow," 115 feet long, is quoted as having actually logged 16½ knots. The fastest speed that Heckstall-Smith ever measured with accuracy was when sailing on the 104-foot schooner "Germania," when she made an even 15 knots off the Isle of Wight.

Coming to the 90-footers, the same authority tells us that he was in an historic race, sailed in a gale of wind from Rothesay around Hilsa Craig and back, a distance of 75 miles—a close reach on the way out and broad coming back. The average speed of the winning 90-foot yawl "Sybarita" was 12.3 knots.

A much higher speed, unquestionably the fastest speed on record for a 90-foot yacht, is that given to us by William Butler Duncan. He tells us that in September, 1899, after the Herreshoff yacht, "Defender," had finished acting as trial horse for the "Columbia," he brought her down from New London to City Island, where she was to go out of commission. It was the last time this beautiful craft was under canvas, and as there was a 25- to 30-knot breeze which held true for the whole trip, Mr. Duncan laid a course sufficiently under the lee of Long Island to insure smooth water, and seized this opportunity to determine just what a racing 90-foot boat could do with a strong wind over the quarter. So he put her to the test with full mainsail, with a jib header above it, fore staysail, jib, and small jib topsail. The "Defender" left New London at 6:07 A. M., and reached City Island at 12:24. After making allowances for the tides, he found that the average speed for the whole 86 miles (knots) was 13.8 knots, and by patent log, the actual speed through the water for two hours was shown to be 14.5 knots, which agrees very well with Heckstall-Smith's estimated highest possible speed of 14.2 knots.

The other estimated maximum speeds could doubtless be verified by yachtsmen who have owned racing craft of the various lengths mentioned, although we think that 13.4 is a little high for a 75-footer. As to the smaller classes, the writer once sailed at 21-foot knockabout from Bridgeport to City Island in half a gale of wind. The course was laid under the lee of the New York shore. The wind was over the quarter and under storm jib and with all reefs in the mainsail, the little boat showed an average speed after tidal corrections had been made, of 7.2 knots.

## The Engineering Skeptic

ENGINEERING practice in its broadest sense covers the process of reasoning which leads us to seek any result whatever through a particular course of action. It is as much engineering practice when the naked savage shoots his arrow a little up the wind to allow for the inevitable deviation as when the modern bridge-builder calculates the load which his structure must bear and the dimensions which will enable it to bear it. And in this broadest sense of the term we may recognize that engineering practice has passed through several distinct periods.

On general grounds there are two fundamentally distinct viewpoints which may be held by the man who approaches a task. He may attempt in some way to predict the result of attacking his task in this way or that way or the other way, and on the basis of such prediction to select the most advantageous procedure; or he may assume at the start that such prediction is futile, and work out his own salvation through a process of trials repeated until an acceptable procedure is revealed. An offhand opinion of almost any intelligent observer would doubtless be that the second-named method is the one originally employed by the primitive engineer, and that the progress of civilization might fairly be marked by the extent to which the process of performance based on prediction has supplanted the crude method of try-it-and-see.

The fact is, however, that there has been a certain swinging of the pendulum between these two procedures. The Greeks, with their supreme contempt for any disconcerting facts which might operate to bankrupt a pleasing theory, assumed that things would work the way a man with an artistic temperament would like to see them work; and in one way or another, they managed to "get away" with this philosophy. After the decay of Greek thought, the world was for many centuries very largely dominated by the try-it-and-see school of thought—people tacitly admitted that they didn't know much about anything, and that the way to find out whether a plan would work was to try it out. The world was kept from complete adherence to this way of doing things by a child-like confidence in the surviving fragments of Greek knowledge and dogma; but in the main the Middle Ages answered practical questions by trial. That their trial was not always an intelligent one, as when they determined guilt by the ordeal, does not touch our argument.

As the modern scientific viewpoint came into being, however, it was realized that valid general inferences might be drawn from specific instances. This led to the formula, deduced from experience and experiment and applied in advance to tasks to be undertaken. The child-like faith of the Greeks in the ability of the human mind to reason out all things on a basis of beauty of thought was replaced by an equally child-like faith in the universal applicability of the formula.

Today engineers are swinging well in the other direction. It is recognized that while the laws of cause and effect are universal, they apply to human affairs theoretically rather than practically. If we apply the formula too freely we shall presently catch ourselves applying it blindly in circumstances that are not exactly parallel; for circumstances are seldom identical, and we can seldom know to what extent and in what manner they differ. And this heads us straight toward disaster, as the many failures of engineering undertakings which seemed on solid ground demonstrate.

So today we still predict by the aid of formulas, and we use in fact more formulas and more complicated formulas and more precise formulas than ever before; but we bring to the aid of the formula an auxiliary, a far less expensive method of try-it-and-see than is involved in the failure of a complete machine to function, or the collapse of a Quebec bridge. Wherever possible we have tests and tests and then more tests, on a full scale or a miniature scale or any scale that is practical; and it is only when by this means we have made as absolutely certain as is possible that the formulas we have applied to the problem in hand are really applicable to that problem, that we proceed to the decisive step of final performance. So in a very large and fine way, the present has become again the age of engineering by trial and error—trial and error directed toward the intelligent control of intelligent prediction.

## Oil Firing in the Atlantic Service

IT is a serious matter to make any radical change in the motive power of the great transatlantic liners, after they have once entered the service. Such ships as the "Olympic," "Leviathan," "Imperator" and "Aquitania" would cost to construct today from fifteen to twenty million dollars, and how expensive it is in these days to do any extended refitting is shown by the estimates of cost, recently made public, of the proposed change of the "Leviathan" from a coal-burning to an oil-burning ship. The fact that the owners of the "Olympic" and the "Aquitania" did not hesitate to withdraw these great ships from service for several months, at a time when they could have been filled to the limit on every trip to Europe, and their willingness to go to the great expense of fitting them with oil-burning equipment, shows how great must be the economic and the other collateral advantages of oil burning in passenger ships of this magnitude.

The "Aquitania" and the "Olympic" can take on 6,000 tons of oil fuel in six hours, as against the four days which were necessary for taking on coal. The latter operation, as everyone knows, is a noisy and altogether dusty and dirty job; the re-fueling of an oil-burning ship on the other hand is a mere matter of hose connections and is altogether silent and cleanly.

One of the most valuable advantages of the change is its effect upon the labor question on shipboard. The number of firemen, which on the largest liners ran into several hundred for coal operation, has been reduced by over seventy per cent, and in the "Aquitania" there will be but four firemen on each watch. There is the added advantage that the total power developed at the boilers is under the direct control of the engineer. In the "Aquitania" there are no less than 168 furnaces; and everyone knows that there is a drop in the steam pressure every watch during the cleaning of the fires. If it be assumed that 28 out of the 168 furnaces are cleaned every watch, it means that about 8,000 horsepower is lost every four hours.

Now, with oil-fired boilers there is no such thing as clogging up of the grate bars by clinkers, and consequently there is no letting down of the steam due to cleaning operations. Once the burners have been started, the temperature of the furnace can be maintained with great regularity. The large reduction in the boiler-room force, coupled with the better-regulated combustion of the fuel, combine to produce great economy as compared with coal firing. Incidentally, it may be mentioned that the reduction in the fire-room force will go a long way to prevent the holding up of the ship on the point of sailing by suddenly announced strikes among the stokers.

Here in America, we have been fore-handed in the adoption of oil firing. The Shipping Board from its very first inception, grasped the great opportunity afforded by our construction of an entirely new fleet of ships and has made a wholesale introduction of the new system. The United States Navy also, is largely oil-firing and probably has a much larger percentage of oil-fired ships on its register than any other navy. This is particularly true of the capital ships and the destroyers, of which we built or commenced a great fleet during the war.

## Aeronautics

**Descent at 450 Miles per Hour.**—Lieut. Weiss of the French Army, was attempting to establish a height record recently but unexpectedly found his supply of oxygen virtually exhausted. The Paris correspondent of the *Morning Post* states that at the moment he was at 8,000 meters and his only chance of safety was to nose dive. For a certain number of seconds he achieved a speed of 450 miles per hour and actually traversed 4,300 yards of descent in thirty seconds. The machine was injured as a result of the strain and certain portions of the wings were torn off, while some supports also were broken before he was able to flatten out the machine for landing.

**Aerial Traffic Policemen.**—During the recent yacht races off Sandy Hook, N. J., the aerial policemen of New York City were given an opportunity of proving their worth. As it was, numerous aircraft hovered over the course of the racing yachts, and some of the more adventurous pilots essayed aerial stunts in order to attract attention. Soon the aerial policemen of the metropolis came on the scene in their high powered airplanes and immediately complete order and straight and sane flying obtained. While the work of the aerial policemen has been slow through lack of funds and support, it is safe to predict that this organization is steadily forging ahead in its work. The personnel includes some of the leading American fliers, and there now appears to be sufficient equipment and facilities to take care of the present aerial traffic.

**Mr. Fokker Speaks.**—Before the Royal Dutch Aviation Association at Rotterdam not so long ago, Mr. Fokker, the well-known designer of numerous German planes, expressed the pious hope that it would not be necessary for him to seek financial help abroad again, but that it would be found in his own country, Holland. He emphasized the need for developing machines which could leave the ground after a very short run, and instanced his new commercial machine as an example of what could be done. He expressed the idea that the improved reliability of airplanes would render seaplanes superfluous for overseas work except for trips between islands. He also pointed out the necessity for the extension of the application of wireless telephone and telegraph, and that the improvement of instruments for ascertaining heights, and so on, is necessary in order to make flights possible in fog at night, and under other hampering conditions.

**Zeppelins for France.**—*Aeronautics* says: France is to take possession of the two Zeppelins which fall to her share under the terms of the Treaty of Versailles. One is the L-72 and the other the LZ, of more recent construction. One will be allotted to the navy and will be stationed at Cuers-Pierrefeu, a naval aviation center in the Var. The other will be transferred to the Under-Secretariat, and will be housed at Maubeuge, in the hangar which the Germans enlarged during hostilities.

**Aviation and the Inventor.**—Writing of inventions we are inclined to believe that there is no field that offers more opportunity to the inventor than aviation. The science is really still in its infancy. Apart from actual constructional devices, there are so many obvious defects in the airplane that require remedies. Chief among them is the necessity for a braking device to give the machine only a few feet of run upon landing. Tail skids galore have been produced, but none can claim to be really effective. Brakes on the wheels have been tried, usually with the result of smashing the nose of the machine. An alterable chord on the wings has not proved altogether successful, and the alterable pitch of the propeller is not popular. The helicopter may come in time, but it is a long way from perfection yet.

## Astronomy

**Standard Time Adopted in Uruguay.**—A circular from the Meteorological Institute in Montevideo announced that, beginning April 30, 1920, the official time throughout the republic of Uruguay would be that of the 60th meridian west of Greenwich. The time signals sent out from Montevideo will in future conform to this time, instead of to that of 56 deg. 12 min. 45 sec. (the longitude of Montevideo).

**Salaries at the Naval Observatory.**—The U. S. Naval Observatory, in common with the other scientific establishments of the Government, is suffering from the monumental indifference of Congress with regard to the effects of inadequate salaries on the efficiency of the public service. According to the last annual report of the observatory, the amount of research work carried on during the last fiscal year was much less than usual. "This is so," says the report, "because of the necessity of employing the higher-grade assistants on certain routine work that could have been done by the three junior assistants had not these positions been vacant. It has been found impossible to fill these positions because of the low salaries."

**Variation of T Pyxidis.**—A bulletin from Harvard College Observatory dated April 9, 1920, records the interesting history of the star T Pyxidis, R.A. 9h. Om. 32s., Dec. —31 deg. 58.7 min. It was discovered by Miss Leavitt on photographs made in 1902, and was at first thought to be a nova. Its magnitude was then 7.4. An examination of 400 photographs of the region in question showed that it was also bright in 1890, while during the intervening years it was of about the 14th magnitude. A period of 12 years was thus indicated, but the maximum expected in 1914 did not occur. Recent photographs show that it has again become bright, after an interval of 18 years, its magnitude now being about 7. From a photograph made April 8, 1920, the star appears to have the early form of nova spectrum.

## CONDITIONS FOR THE $5,000 PRIZE EINSTEIN ESSAY CONTEST

1. No essay shall be longer than 3,000 words.

2. All essays must be in English, and written as simply, lucidly and non-technically as possible.

3. Each essay must be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted.*

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned..

9. The number and personnel of the Committee of Judges will be announced in an early issue.

*[The donor desired that in case the Judges were not able to agree upon the winning essay the prize might be divided between the contestants offering the best two essays, but the Post Office Department has objected to such a condition being published, so the matter is held in abeyance until definitely decided. Announcement will be made later in regard to the matter.—THE EDITOR.]

## Engineering

**Connecting Japan's Islands.**—A project for connecting Nippon, the main island of the Japanese group, with the neighboring island of Kyushu by means of a tunnel starting at Shimonoseki was originated by a Japanese shipping magnate, according to the *Economic Review*, but has been taken over by the Government, which is averse to giving out many details. It is understood, however, that borings have been made in the sea bed near Shimonoseki in order to ascertain the geological formation, and that in order to reduce the angle of inclination, the descent of the tunnel will commence about a mile from the coast, and at first run under the narrow channel between the mainland and the little island of Hikoshima, on which an underground station will probably be built. From there it will run under the actual Strait of Shimonoseki as far as the Dairi district a few miles to the west of Moji, where it will join the Kyushu railway. It is estimated that the construction of the tunnel, which will be six miles in length, will cost $12,500,000, and will be completed in 1929.

**Europe's Largest Cold-Storage Plant** is nearing completion at the Alexandria Dock, Liverpool. The first section of the store opened in August last, has a capacity sufficient for the storage of 11,000 tons of foodstuffs. When completed the total cubic capacity will be over 3,000,000 feet and the accommodation will approximate 30,000 tons of eatables, including meat, fish, poultry, game, eggs, butter, and cheese. The equipment will be the most modern obtainable. In order to avoid exposure of meat in transport from the ship to the shore, the adjacent dock sheds have been fitted with a system of conveyers which enables the meat to be picked up at any point and conveyed under cover direct to the store, thus avoiding any break in the refrigeration.

**Germany's Railroad Electrification.**—Coal as a power producer will be replaced so far as possible by the use of peat and the electrification of railroads in the vicinity of the large German cities, according to *Commerce Reports*. Great hopes are being placed on the new Theissen 10,000-horse-power vertical gas turbine, two of which have been ordered for use on the German railways. It is hoped that they will be able to replace the coal-burning locomotives. In regard to the electrification of the German railways near large cities it is planned to install large central power stations, which will be equipped with peat-burning furnaces. The peat bogs in the vicinity of Osnabruck will furnish this fuel. Machinery for the working of this peat has been installed, and it is hoped that the first deliveries will take place by September 1st next. Experiments are being made by the German Government with machinery for pressing the peat, so that it may be transported economically.

**The Teredo** does not actually eat the wood, but cuts into it as a place of abode while deriving its sustenance from the sea water, according to a recent account in *Railway Maintenance Engineer*, dealing with the ravages of the teredo and other insects of wood-boring habits in timber structure immersed in sea water. Impregnation with creosote has given a considerable degree of protection in many cases, but it has to be very thorough to be effective. Examination of creosoted structures that have been attacked has usually revealed incompleteness of the impregnation. Various forms of protection by external coverings have also been tried, including metal sheathings, coverings of burlap or sacking and protective pipes of cast iron, concrete or terra cotta. Practically all except the actual pipes proved of little value because their usefulness was quickly destroyed by breaks in the covering.

# Our Future Oil Supply

## A Hopeful View of the Possibilities of the Mexican Fields

By A. Hooton Blackiston

THE age of petroleum is here. From an humble beginning in 1859 it has now reached a point where it is consumed in ever increasing quantities until the problem of its production has become one of the most absorbing of international questions—to that country which controls the output belongs the power of the world.

Therefore, Great Britain, the smallest producer though realizing its importance, is struggling with every nerve set to acquire through purchase or otherwise the control of the known or prospective oil bearing areas of the world in Persia, Burma, China, the Balkans, Peru, Venezuela, Mexico and even in our own country. Meanwhile America, the home of the industry and the world's largest producer and consumer, sits idly by and watches its laurels slowly fade away.

Oil production means control of the sea and of the air and consequently of the land. It is time our Government wakened from its lethargy and encouraged production at home and abroad if we are not to be left behind in the race. Though we have produced over 60 per cent of the world's supply to date, we are now consuming more than we produce and the demand is increasing by leaps and bounds.

Petroleum is the genie that answers the lamp of Aladdin in a far more effective way than did the genie of the fable. It courses over vast stretches of country in its own pipes to do our bidding, it draws our trains, it cultivates our crops, it harvests them and hauls them to market, it drives and lubricates the wheels of industry, it heats our very buildings, it propels our navy and merchant marine, and in the submarine and the airplane it broks no rival. It does its work smoothly, effectively and economically.

And petroleum we must have, for we have built millions of machines that use nothing else and thousands of miles of road good only for them; we have adapted our vessels and locomotives to its use and are every day becoming more dependent upon it. Not a wheel turns but pays tribute to petroleum. Its sudden cessation would rock our present day civilization to its base.

The products refined from it are legion. There are over three hundred separate products made from petroleum. High explosives are distilled from it, medicines, dyes, and even artificial flavorings—and yet we have but begun to understand this modern wonder-worker.

It has cheerfully lifted the burden of labor from the back of mankind and his steadfast friend, the horse, and saved the drudgery of countless millions. In war it is our defense, in peace our aid, and in sickness our solace and our comfort.

However our reserve storage of crude oil has fallen off in the last eighteen months fifty million barrels and is decreasing at the rate of 10,000,000 barrels a month. In the face of these facts it is time we realized its national importance and looked ahead for our future supply.

*IN the midst of the prevalent gloom over the petroleum situation, it is refreshing to hear a note of optimism. We are usually told that the American supply is diminishing and will continue to diminish permanently; and that no substitute source of supply is in sight. Mr. Blackiston speaks from long familiarity with the Mexican field, and argues that this is not the case—that the republic south of us may be looked to for ultimate stability and a very large quantity of oil products.*

*But with his hopeful outlook he couples the suggestion that unless we bestir ourselves, we shall find the world's liquid fuel as completely in other hands as in the past it has been in ours. It is no remote inference, granting the validity of his arguments, that we may yet see the day when Britain will wallow in petroleum as we do now, while we parcel out the precious gasoline by the quart and even the pint, as Britain does today.*

—THE EDITOR.

The world's total output was 514,724,354 barrels in 1918. The United States produces approximately 69 per cent of the oil of the world and when combined with Mexico, about 81 per cent. In 1919, while we produced in round numbers 376,000,000 barrels our consumption was about 418,000,000 barrels; the difference of about 42,000,000 barrels was imported from Mexico, our nearest available foreign supply and the country which contains the premier wells of the world. Therefore, the Mexican fields are of particular interest to us when debating from whence our future supply is to come.

The petroleum industry in Mexico is only sixteen years old. It may be said to have been begun by Americans in 1904 in the Tampico district, though oil seepages were noted by the early Spandiards, and an attempt to drill was made in 1868, with no important discovery.

And yet, in spite of the newness of the industry and the numerous setbacks it has experienced through political conditions, the possible production of the country is estimated at nearly 2,000,000 barrels a day, though less than 9 per cent of this amount is exported at the present time, and but a fraction of Mexico's oil territory has even been prospected. In the brief sixteen years of its development it has climbed to the place of second producer of the world, and its wells are without a peer—indeed so far ahead of the others as hardly to admit of comparison.

It is a long cry from Drake's pioneer well near Titusville, Pennsylvania, in 1859, with its feeble stream of forty barrels a day, to the monarch of the world's wells, the famous Cerro Azul No. 4 of Mexico, which tossed its black column six hundred feet high into the air, and in unbridled freedom hurled over one million barrels of oil toward the skies before it was finally placed under control. It gushed at the rate of nearly three barrels a second, which would be 180 barrels a minute, 10,800 barrels an hour, or nearly 259,200 barrels a day, and at present is filling its eight-inch pipe lines running direct to the tankers at Tampico which are waiting with eager maws its flood of liquid gold. It is now producing at the rate of about 125,000

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1. The standard bearer of our future oil supply—the test well, which today, with the aid of the scientist and the latest mechanical devices, indefatigably searches out the pools of hidden oils and opens new fields. 2. The driller has to be constantly on the job. 3. Incidents like this one in our own oil fields do not help matters.

**Snapshots from the oil fields of Texas where oil is king**

*Left:* An ancient installation of a type now almost forgotten. *Right:* The No. 1 board in the Chelsea exchange, New York City

**Thirty years' progress in telephone switchboards—to say nothing of feminine apparel**

## Scrapping Good Machinery for Better Service

By H. A. Mount

OUR great public service corporations spend many millions of dollars every year in replacing machinery and equipment, the mechanical usefulness of which is almost unimpaired by use. It is replaced because it has been antiquated by some new invention or development that gives better service.

To the uninitiated it would seem that the public might be spared a very great expense if this constant replacement of good equipment were stopped, or at least carried on less vigorously. But even a superficial examination of the facts discloses that it pays. Not only from the standpoint of the public is the process an economical one, but it pays dividends to the companies. And of course, that is the real reason for it. It pays so largely that the largest companies maintain great research organizations whose business it is to make antiquated the company's machinery and equipment—to find new ways of doing things.

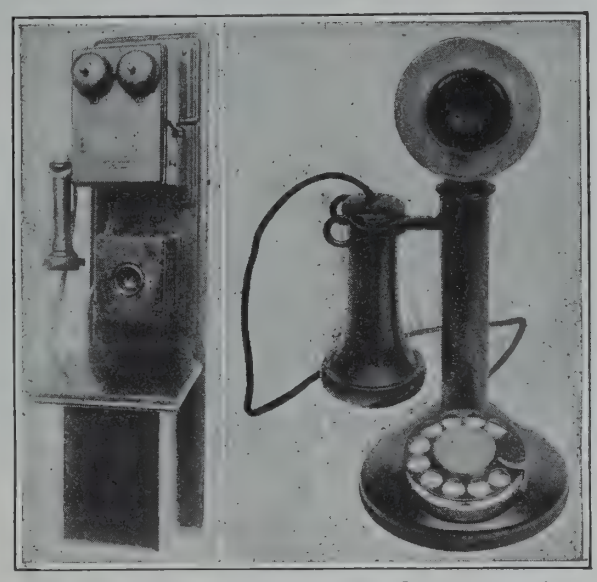
One of the striking examples of these statements is the electric light and power companies all over the country. There is hardly a central station in the United States which has not almost completely changed its equipment within the last ten years because of the rapid strides in electrical engineering. And yet the original equipment, if it had not been junked, would in most instances have been giving just as good service today as it did when installed.

The largest single powerhouse in the world, in point of electrical output, is one of the great stations which supply power for the operation of New York's subway system. Eight years ago this station was equipped with great reciprocating engines of 100,000 horsepower each, that were the finest engines of their kind in existence. It was estimated that they were good for a century of service. And yet today only one of these great engines still stands and it is used only in emergencies. The others have been replaced by a battery of comparatively small steam turbines that take up much less space and have a far greater power output.

The saving in fuel alone justifies the junking of all this costly machinery. The saving in space allowed for great expansion in power capacity without additional buildings. In this case junking good machinery has paid big dividends.

An even more striking example is our telephone system. Constant replacement is going on here on a stupendous scale. The most recent development in telephones is the automatic switchboard which does away with the much-abused but faithful servant "central." Connections are made automatically. The introduction necessitates replacement of almost the entire telephone equipment, but already the process has been begun and eventually it will extend to every city and town in the country. The saving in labor alone justifies the cost, aside from better service to the public. There will be no reduction in the number of employes, however, because of expansion of the system.

A few years ago the great mass of telephone wires in the cities made it necessary to use cables for transmission. At first only a few wires could be placed in a single cable and even then what seemed almost insurmountable difficulties presented themselves. The great cost of the cables and the expense of laying them, especially underground cables, made it necessary to put as many wires as possible in a single cable.



**The Blake transmitter of 1886, and the automatic instrument in use today**

An intensive engineering study of this problem has been going on and the difficulties have disappeared one by one as more and more of the overhead wires strung on telephone poles were replaced in cables underground. Finally, it became possible to place as many as 2,400

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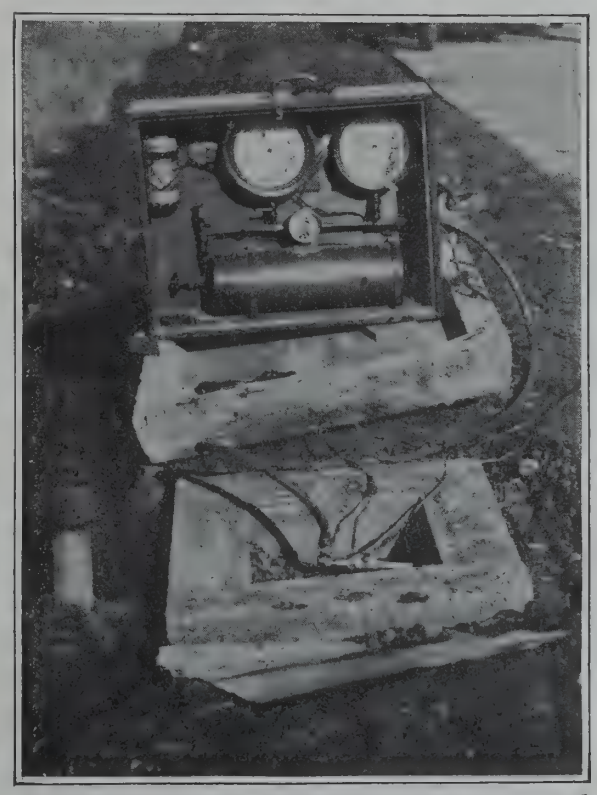

**The measuring box that reveals the pressure of a road on the bed of soil beneath it**

## How a Road Rests in Its Bed

By S. R. Winters

THE character of the support given a road surface by the underlying soil and the manner of distribution of pressure when highway slabs are subjected to the impact of heavy traffic, is scientific information for the first time disclosed by an ingenious apparatus designed by the U. S. Bureau of Public Roads. The tests are being conducted on a concrete highway leading into Camp Humphreys, Virginia, where army motor trucks with enormous cargoes of freight constantly travel.

The experiments are being conducted by a measuring box which has immediate connections with a pressure device located between the surface of the highway and the underlying soil. The initial tests showed that the effects of a motor truck at rest are never sufficient actually to shatter the road surface, this knowledge being of valuable assistance to highway engineers in proceeding with experiments in revealing the influence of trucks in motion and the effects of the impact.

It has been discovered that even a concrete road, stable and massive as it appears to be, is never for a single instant perfectly at rest on the underlying soil. It continually vibrates, which movements change the pressure exerted between the road surface and the underlying soil—a condition characteristic of any highway when traffic is passing over it. Irrespective of the size of the object, when a weight is placed on any kind of material, the latter is bound to deflect. The degree of its motion is dependent, of course, on the magnitude of the load applied as well as the kind and shape of the material. A road slab when subjected to oppressive motor truck traffic bends considerably, especially when the slab is resting on soft soil. If the bend is excessive, a crack is formed in the road surface.

The problems of highway engineers are constantly shifting front and each successive stage of changes presents fresh difficulties. In 1899 there were only 3,700 passenger and commercial motor vehicles manufactured in the United States. Previously the horse-drawn vehicle, having iron tires, produced an abrasive effect on roads, the surface wearing out under the continual grinding action. With the advent of the comparatively light motor conveyance, the effect of the rubber tire is to scatter huge clouds of dust, the fine stone particles tending to bind the road together—soon leaving but a stretch of disintegrated stone.

The third stage of highway engineering—the introduction of heavy motor trucks—has brought fresh problems. The new type of conveyance rumbles and pounds over the road surface, in many instances shattering the highways because they are unable to withstand the impact of excessively heavy traffic. So it is now a problem of design—the ultimate object of the Camp Humphreys experiments being to give the engineer complete information for designing highways when the surface rests on any type of soil.

## Soap from Lignite Tar Oils

EXPERIMENTS, which have been said to have a satisfactory result, have been carried out in the laboratory of the Siemens works in Berlin, with a view to converting lignite tar oils into fatty acids by the action of ozone. Similar experiments carried out on a large scale by a process introduced by the city of Wiesbaden have led to equally satisfactory results.

# The Romance of Invention—XV

## Frederic E. Ives, Wizard of Color and Light, and Father of the Half-Tone

By C. H. Claudy

THE probabilities that the reader has ever heard of a "kromoskop" or a "parallax stereogram" are small. But no one who reads but has seen half-tones, either black and white, two-color, three-color or four-color and has thus had his quota of pleasure and profit from the inventions and discoveries of America's most eminent authority on color processes, the distinguished inventor to whose resourcefulness and ability the world owes its premier method of illustration, indeed, the method which revolutionized the printing industry.

Mr. Ives, who confesses to sixty-four years, of which he looks about fifty, has spent those fifty in photography, first as an amateur, next as what those who recall his work there still speak of as the most competent photographic laboratorian Cornell University ever had, and the rest of the time in his own workshops and laboratories, where he has worked out hundreds of inventions, practically all dealing with light, optics, lenses, color processes and optical instruments of precision and photography.

Mr. Ives' story is so diversified that it is difficult to know where to begin. At best, no story the length of this article could more than outline his achievements. He himself, probably justly, regards his invention and perfecting of the half-tone process as his greatest claim to fame; but it is none so sure that a world well used to half-tones may not longer remember him as the first to invent, patent and perfect a "real" system of color photography as applied to the motion picture.

For this is Mr. Ives' latest contribution to the worlds of science, art and commerce; and that he has succeeded is not claimed upon theory, but upon the actual production of actual films in colors, which colors are in the films themselves, and are not added thereto by means of colored screens, a method which produces a color "flicker" or "color fringes."

It would be difficult if not impossible to describe the process in detail in a short space or without illustrations, but its simple principles may be outlined. Briefly, then, the process includes the making of two negatives simultaneously in two side-by-side cameras, synchronously operated. These two negatives are made, one by direct light through a di-chromic screen, the other by reflected light from the same screen, and both, by the use of prisms, from the same optical viewpoint. This screen is the wonder in the process, as it *transmits* red and *reflects* green light. From the resulting two negatives two prints are made, the first of which is direct upon ordinary positive film, which is then dyed with red. The second negative is then superimposed upon the dried and *resensitized* film, making a second print which comes out blue. By a chemical differentiation the first color gives not only the reds but the yellows and thus this strictly two-color process gives to the eye a three-color effect. The limitations of the process are in the slowness of printing the blue, which holds one printer's output down to about three hundred feet of film a day, and the expense, which is double that of ordinary black-and-white film. But the result is true color photography for the "movies" and Mr. Ives expects to cheapen and quicken the process to an everyday commercial standard. It has the great advantage over other moving-picture color systems that it uses standard film, a standard projecting machine, works at standard *or slower* speed, has *no* color fringes or flicker, and on account of the dichromic reflector used in place of ordinary color screens, can "take" the negatives with one-half the light (or half the exposure) used by other systems of moving-picture color photography.

Mr. Ives has invented so many systems of color photography that one rather fancies him several times a millionaire.

"Nothing of the sort!" he said, in answer to a question. "I never made much money out of any of my inventions. I am not interested in the business end of them, but in the problem. I have taken out sixty-five United States patents and many of them are in use today; but, alas, many of them lay idle until they expired and someone else has reaped where I sowed. Luckily, my pleasures are not in making money, but in doing the things which have to be done—solving the problems.

Had Mr. Ives received a fraction of a cent royalty on each square inch of every half-tone ever etched he would be so wealthy today that Rockefeller would appear poverty-stricken. When this was pointed out to him he smiled—he has a singularly vivid smile—and answered gently: "It's something to know that one's work has been of so much use to the world—something to be the father of the half-tone."

The inventor of the half-tone and of the motion-picture in color

"What do you think of the future of color photography for the amateur?" was asked.

"There are several processes he can use, if he will," was the answer. "But he won't. They are all a little too complicated and dainty in operation. The professional uses them little because of the expense attached, which makes it impossible to do as the average sitter expects—make a half dozen negatives and give her a choice! But any system of color photography which depends upon pigments on paper, no matter how applied, is at least but a compromise. The only absolutely truthful color process is my old "kromoskop" process—and the 'man in the street' called that a fake!"

Whereupon Mr. Ives demonstrated it to me, and would there were more fakes as beautiful! The kromoskop process shows a stereoscopic picture without any structure (such as half-tone dots or stripes or other grain) in absolute fidelity to nature's colors, be they violent or subdued. But the picture is a *picture of light*, must be viewed through a special instrument, is small and, of course, cannot be framed or put in a book for the parlor wall or the living room table.

"I was exhibiting this in London shortly after I invented it," Mr. Ives recalled, "and had a number of criticisms. One was from a successful artist, who said my greens were all wrong because they were a dull brown. Another was from a successful art critic who declared my greens were too brilliant and metallic. I let them argue the matter out with each other, and, for all I know, they are arguing yet. Neither would believe what I knew to be a fact, that one was slightly color blind on greens and the other on reds! For it is an oddity of this process that it reproduces colors perfectly for the normal vision, but not for the color blind!"

"You have received some medals for your work, I believe?" I ventured.

"Yes, some. I'll show them to you if you want."

I did want. Mr. Ives went out of the room (this was in his pleasant apartment in Philadelphia) and returned in a few moments. "I couldn't find them all," he said, "but these will do."

I imagined they might. The man came in with a *tray* literally dripping cases of medals—medals gold and medals silver, medals bronze and medals something else, medals large and small and intermediate. There are *five* John Scott medals from the Franklin Institute of assorted dates and for assorted accomplishments. One is for the diffraction chromoscope, another for Rowland diffraction-grating replicas (now used all over the world and making available for laboratory use a tool of the laboratory in scarcely less perfect form than the original itself, at one-fifth the expense) another for projecting lanterns, a fourth for isochromatic photography and the fifth for the "parallax stereogram," which is an oddity of science in which an apparently single picture, looked at without any apparatus, appears in strong relief. A modification of this invention, also patented by Mr. Ives, is frequently seen in advertising novelty displays in which a picture changes as the viewpoint changes—everyone is familiar with the first smiling, then frowning youth who changes his expression, actually with your viewpoint, apparently as he does or does not use so-and-so's shaving cream!

Mr. Ives has the Royal Photographic Society's Progress Medal, the Medal of the London Society of Arts (which he had forgotten he had won until he opened the case!), the Medal of the Photographic Society of Vienna, the Franklin Institute Elliot Gresson Medal, the Rumford Medal of the American Society of Arts and Sciences, the Royal Photographic Society of Great Britain Science Medal, the J. Traill Taylor Memorial Lectureship Medal, the Franklin Institute Medal, the International Inventions Medal (London), a special gold medal from the Photographic Society of Philadelphia, the Medal of the Royal Scottish Society of Arts, an inscribed watch from the International Society of Photo Engravers, the Franklin Institute Longstreth medal, and several Exposition medals.

Speaking of expositions reminded Mr. Ives of an amusing experience he had while exhibiting in Buffalo. The kromoskop takes its pictures in ordinary black and white and exhibits them in colors by the use of reflecting and refracting color screens. An authority of the exhibition in question wished to throw the exhibit out on the ground that it was a fraud and that any photograph viewed through color screens would appear as a colored photograph! This was matched by the comments of some near-scientists, when he exhibited what he calls "freak diffraction gratings" which behave as no ordinary grating could or should. The way they were made and the peculiarities of their performance were explained to the amusement of some students of optics, who apparently thought Mr. Ives a harmless but deluded crank who had stained some "regular" gratings. However, Pro-

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*AMONG all the inventors whose work lies in some chosen and restricted field, none has elected a field in which the possibilities have turned out to be greater than in the field of photography. Photographic work, when Frederic Ives first took it up, was circumscribed enough. Largely through his inventions, this state of affairs has undergone a radical change, and today there are few arts of wider or more various application than the art of photography. It is a far cry indeed from the mysterious half-tone, with its little patterns of dots that make pictures, to the achievement of color photography and color motion pictures and color stereograms and the binocular microscope and the stereoscopic photomicrograph. Yet all these extensions of the photographer's province are the work of this one man, whose story Mr. Claudy here tells us.*—THE EDITOR.

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

## A Word for the Steam Automobile

To the Editor of the SCIENTIFIC AMERICAN:

The SCIENTIFIC AMERICAN has published from time to time descriptions of new types of steam automobiles and has likewise devoted considerable space in its correspondence columns to a discussion of this type of machine. Although the relative merits of the steam-driven and gasoline automobile have been a fruitful source of argument for twenty years, it seems to me that there are still a good many points that are not yet settled and which will bear further investigation and discussion.

I was much impressed by a letter of Mr. W. J. Parish, published in your issue of November 8, 1919, in which he gave his opinions very frankly concerning the steam car situation as it exists today though I think he magnified unduly the disadvantages of the steam car. As I have been familiar with steam automobiles for a number of years and own one at the present time, I should also like to express my views on the subject, perhaps along rather different lines from previous letters which I have read. I think that the present comparatively small use of steam automobiles can be explained by the fact that the motoring public of the present day is almost wholly ignorant concerning them. If one will go back to the early volumes of automobile journals, say along 1900 to 1902, one will find that at that time the steam machine existed on an equal footing with the gasoline car. In fact, it was probably more distinctly the American type of automobile than any other motor car then being manufactured. The steam machines built in those days were a remarkably highly developed type of automobile considering the time at which they were built. They were, however, for this very reason, considerably more complicated than contemporaneous gasoline machines with the possible exception of some of the imported French cars. Those were the days of very rapid development of the gasoline automobile and improvements were introduced almost daily. As the gasoline machines then built were very simple while the steam machines were even more complicated than the ones produced today, there was a decided swing away from the steam machine which seemed to be forgotten by a large part of the motoring public. Meanwhile the gasoline car improved in performance but only at the expense of additional complication, till in this respect it far exceeded the steamer.

A good many advocates of the steam automobile say, and I think not without truth, that if the two cars could start on an equal footing today the steam machine would soon be used in as large numbers as the gasoline.

The steam automobile at present is bought and used by people who thoroughly understand it and appreciate its many good qualities. From those I know who own this type of automobile I would say that scarcely one of them has bought a steam car with the same object in view as the average man who buys a gasoline machine. Steam-car owners are nearly always well acquainted with such machinery and are quite expert in doing their own repair work. These men can get the most out of the steam car; they know how to handle it intelligently and in case of any trouble are not dependent upon a service station. This is almost necessary in some places as today comparatively few repair men are familiar with steam automobiles. The owner of a gasoline car, on the other hand, buys one with the idea merely of running it and in the case of any breakdown taking it to the nearest repair station. I should say that fully three-fourths of the owners of gasoline cars do not thoroughly understand the mechanism and are not competent to do much repair work upon it. However, as they can always find any number of shops and garages within easy reach, they can get repair work done for them if they will pay the price.

I think that it is a mistake to try to compare the two types of cars as they are so utterly different. It is useless to suppose that a steam car, even with a flash boiler, can be built which can be started as easily as the modern gasoline car with its electric self-starter. (I refer, of course, to those times when the gasoline engine is in proper running order and will start after one or two revolutions.) Quick starting after a long period of disuse is the legitimate and great advantage of the internal combustion engine. Any boiler having a reserve capacity requires some little time to generate a head of steam from cold water. This is the disadvantage of the steam car, but I do not think it is as serious as the advocates of the gasoline machine would have us believe. After all, the times when we need a car on one or two minutes' notice are comparatively rare. The average man can nearly always tell a few minutes ahead when he will need his automobile and the length of time is generally sufficient to get up steam. If he needs a car that can start at any time on a few seconds' notice, he ought, of course, to buy a gasoline one. On the other hand, it is absolutely useless for the builders of gasoline cars to attempt to duplicate the steam car's performance as regards flexibility of control and ease in acceleration. These qualities are inherent in the steam plant and the various expedients such as gear shifts and multiple cylinders introduced on gasoline cars, are really only excuses for a type of motor which is fundamentally poorly adapted to variable speed work.

I do not attempt to argue that the gear shift, and 4, 6, 8 or even 12 cylinders have not been fairly successful. They have made the present day gasoline automobile possible, but, nevertheless, they are excuses all the same, and from the scientific point of view the gear shift is the weakest element of the whole car.

Good as the performance of the modern gasoline automobile is, considering the handicap due to the type of engine, the machine as a whole is, nevertheless, a collection of very complicated mechanisms and its reliability is really to be wondered at when one considers the amount of auxiliary equipment upon which the correct functioning of the whole machine depends. The steam car, on the other hand, is much simpler. It is true that there are valves and pipes and the burner to be looked after. All of them may give trouble, and yet it is almost impossible to "stall" a machine of this type if one or more of the parts of the power plant are out of order. Its performance on the road is so excellent that to my mind it is a strong argument for the use of such cars even when one considers their disadvantages, and these are not really serious drawbacks to any one who understands them. Before any large number of people can be induced to purchase this class of machine, they will have to become more familiar with it and with the theory of steam operation. While, as I have already stated, I think that three-fourths of the owners of gas cars do not really understand them, they think that they do, and they know that they know nothing about steam cars. The failure to educate the public along these lines is perhaps due in a large measure to the attitude of the steam car manufacturers themselves who have been content to sell their product to the few who really appreciated them without attempting to induce others to buy. Likewise, many owners of steam cars have apparently got a lot of satisfaction by giving the impression that such machines require vastly more intelligence to operate than the gasoline type which, I may be pardoned to state, is not at all the case. What is needed is familiarity with a different kind of machinery, functioning in a different way, and yet basically far simpler than the gasoline car.

There is a field, to my mind, for the steamer which cannot be filled so well by any other type of car. Likewise, there is the legitimate field for the gasoline vehicle. No argument is required today to prove that the gasoline and electric types of automobiles are both useful for certain particular purposes. Why can we not have the same attitude toward the steam machine? It is capable of doing wonderful work and for certain uses where its disadvantage, the inability at quick starting after a long period of disuse, is not a serious factor, it is the logical type to select, on account of its many other superior qualities.

Think of the great advantage of being able to burn completely and easily a cheap and heavy oil instead of gasoline for fuel! I have used both gasoline and kerosene burners and have had better success with the latter and have got greater mileage from my car. Burners can without doubt be designed to utilize even heavier fuels, and I think the time will come when engineers will be forced to recognize the fact that the solution of the automobile fuel problem is to be found in the steam car. Why go to the Diesel engine, which is even less adapted to vehicular work than the familiar gasoline motor, when the reliable and simple steam plant can be used?

I think a more friendly discussion of the subject is in order and might lead to much real good for the automobile-using public.

HUGH G. BOUTELL.

Washington, D. C.

## Visible Sound Waves

To the Editor of the SCIENTIFIC AMERICAN:

In connection with a letter of mine which was published in the SCIENTIFIC AMERICAN on March 6, 1920, under the above heading, my attention has been called to the fact that there may be some misunderstanding of certain statements made therein.

I referred to recent studies by Professor Sabine in connection with photography of sound waves and stated that his perfected apparatus was the result of several years of patient and skilful development. I did not wish to detract from the work of those others who have labored on the same subject and by whose studies Professor Sabine was able to profit. Professor Sabine called his method "A Modification of the Toepler-Boys-Foley method of photographing air disturbances."

Professor Arthur L. Foley of the University of Indiana, has done especially fine work along this line and my attention has been called to the fact that the SCIENTIFIC AMERICAN for February 15, 1913, published a number of excellent photographs taken by Professor Foley.

The development work done by Professor Sabine has resulted, in the opinion of the writer, in a method of photographing sound waves which is appreciably more satisfactory for the problems involved in architectural acoustics.

I hope you will give space to this letter in an early issue, as the writer does not want to have his letter convey the impression that Professor Sabine was solely responsible for the development of the modern methods of sound wave photography.

WM. H. CAPEN.

New York.

## Duluth to Liverpool

To the Editor of the SCIENTIFIC AMERICAN:

I have read with interest Mr. Skerret's article under the above title, which is an admirable statement of the project, and the reasons for it as we understand it.

I note your editorial in the same issue. I agree with you. New York should develop the Barge Canal to the fullest possible capacity. The West wants it and will use it for all it is worth.

The West wants all the service it can get from the railroads by any possible expansion of their facilities. It wants all the relief it can get from the present intolerable situation by the services of the Barge Canal, and it wants an entirely new outlet that it may have leave to grow according to the measure of its capacity.

What can the railroads do? Give them all the money they can spend. Give them carte-blanche—and in ten years they will have caught up with today's necessities. The West, meanwhile, is eager to expand its production. It looks as though the West must wait.

Perfect the Barge Canal. Work it to its capacity. The most it promises is a carriage of ten million tons a year eastbound. When the New York people proposed the Barge Canal as an adequate measure of relief, they remind me of the innocent gentleman of Boston who asked, "What is the matter with the Hoosac tunnel?"

Within four years from the time when Congress may act they can have relief through the lakes-to-ocean route. We can get relief in quicker time in the present emergency by this measure than by any possible improvement in the railroad situation. We can get adequate relief by this means where the Barge Canal will only allow a little trickle of traffic.

By all means let New York make the most of the Barge Canal, but do not make the fatal mistake of imagining that the country between the Alleghanies and the Rocky Mountains can find in that narrow channel an adequate outlet for the production, of which it is capable.

We welcome your views. I am sure that a further study of the intolerable conditions under which all these states suffer will bring you to a point of view identical with ours.

C. G. HARTLEY.

Duluth, Minn.

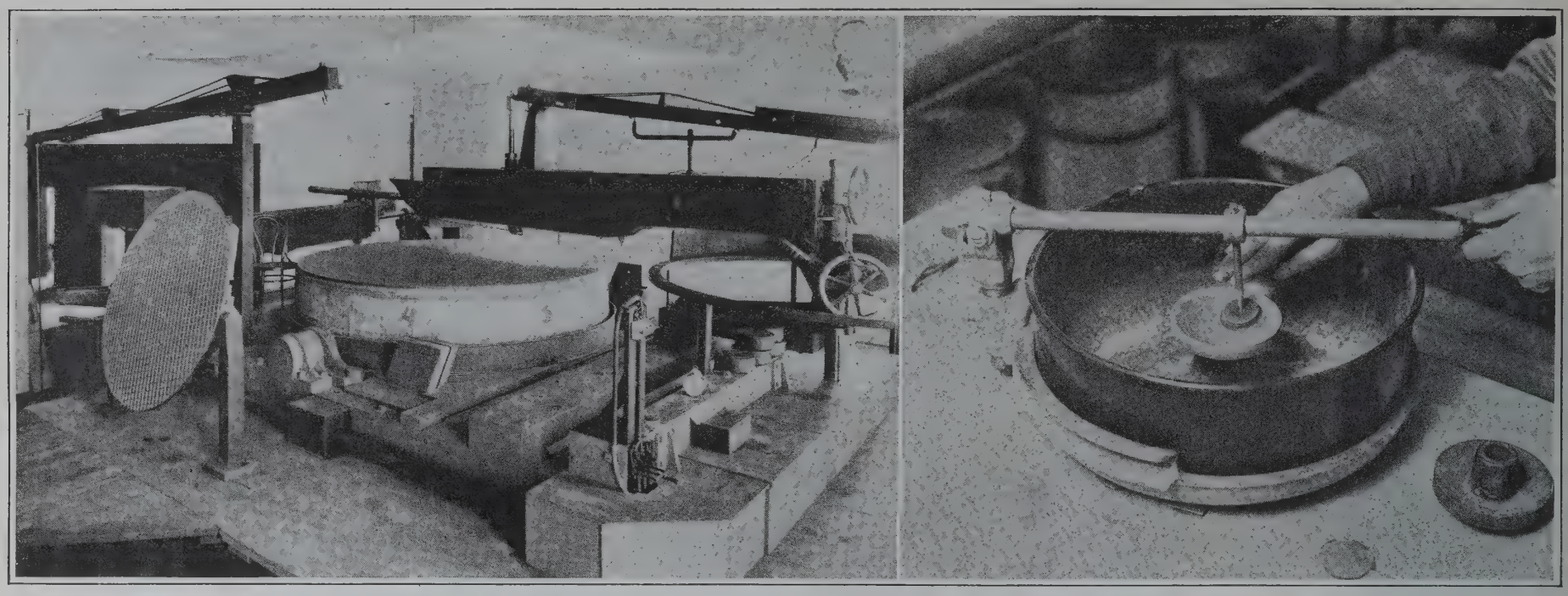
## Saving Shoes

To the Editor of the SCIENTIFIC AMERICAN:

I read in a recent number of vaseline applied to shoe soles to save wear. I believe a better remedy which I have used a long time is boiled linseed oil. Saturate the sole. Makes it hard as rock.

CHARLES A. WHEELER.

Los Angeles, Cal.



*Left:* The 100-inch mirror for the Hooker telescope on the grinding machine ready for concaving. *Right:* Finishing and surfacing a lens

**Two phases in the manufacture of huge and small reflectors and lenses**

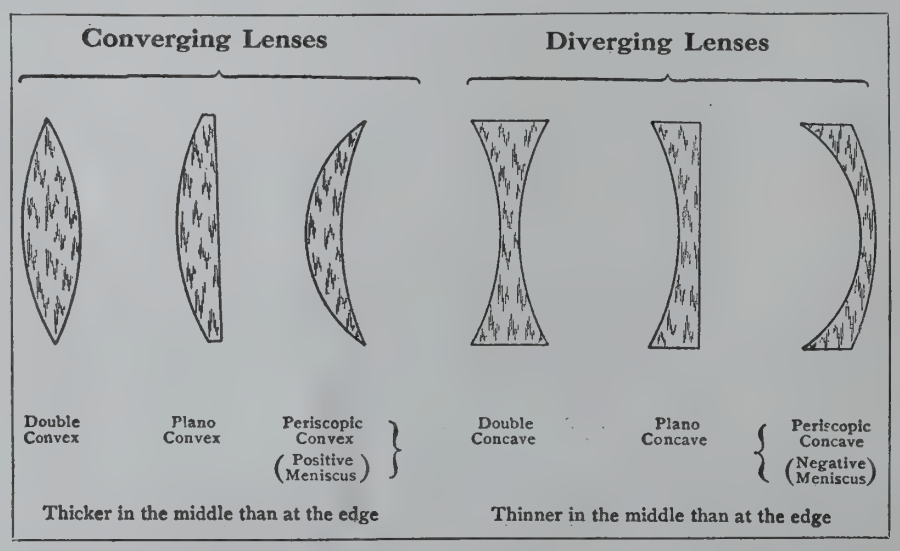
# Our Mechanical Eyes

## Glass for Optical Purposes, and How It Is Made

By J. F. Springer

WE are so familiar with glass objects and the material enters so into our every day life that it would be difficult mentally to reconstruct the world and visualize what our present civilization would be without it. And yet, the ancients either didn't have glass or had it only in a restricted way. Near the beginning of the Christian era, glass became known to the European world. The ruins of Pompeii, which was overwhelmed in 79 A. D., have yielded examples of small window panes. In these same ruins was found a plano-convex lens, presumably of glass. As lenses may be, and have been, made of rock crystal and other transparent substances, it would be unsafe to conclude that the ancient existence of a magnifying lens means a contemporary knowledge of glass. From the ruins of Nineveh, a city destroyed about 600 B. C., has been recovered what is probably the oldest known lens. It is plano-convex and is of rock crystal. It is not quite round, measures 1.6 x 1.4 inches on its axes and is 0.2 inch thick. Its refractive power is 10 diopters. This and other old lenses are, it seems, all of them of the convex class—thicker in the center than elsewhere. Pliny and Seneca, both of the first Christian century, tell us in effect that the Greeks and Romans were well aware that a glass globe filled with water produced a magnifying effect.

In our own days, glass objects are everywhere. Optical applications are very familiar. In fact, the number of spectacle lenses in actual, everyday use is enormous and their manufacture has become a very considerable department of industrial activity. Glass is used for giant lenses in our big refractive telescopes and in the construction of still larger reflecting mirrors used in certain great telescopes.




**Leading types of lenses in use in some of our cameras and other optical goods**

The reasons for the supremacy of glass in optical manufacture are, some of them, obvious or nearly so. Its wonderful transparency is one of these reasons. Its homogeneity is another. Then it may be molded or otherwise simply fashioned to approximate form and finished by grinding processes to an exactitude well-nigh inconceivable.

The small lenses used in spectacles and eye-glasses are made in enormous variety. Those required for big and little telescopes and for similar instruments greatly increase the ranges of variation, both in form and size. Nay, in optical matters, glass is not simply glass. There is, in fact, a big variety in the material itself.

In general, optical glass falls into two classes—lime glass and lead glass. The lime glass should, however, not be the usual thing used for ordinary bottles, window panes, etc., but a very clear variety. It is then called *crown glass.* Lead glass, often termed *flint glass,* is invaluable for special optical purposes. It may be made so as to possess a very brilliant luster, a high specific gravity, a high refractive index, and other good qualities. The two types of glass, lead and lime, may be conjoined for the purpose of securing optical results that are not readily possible with either alone.

One of the leading manufacturers of optical lenses says, in effect, that there is no glass in existence which possesses all the desired qualities in the highest degree. Clearness and responsiveness to molding operations are highly desirable. But optical requirements impose such further qualities as high resistance to atmospheric influences. Moist air, because of its content of carbon dioxide, acts upon glass surfaces by way of reducing brilliancy and transparency. Glass exposed to the air becomes more or less tarnished or coated, and the alkaline content at and near the surface is dissolved out, leaving silicic acid in the form of fine scales or flakes. These are naturally no longer glass.

The optical manufacturer can naturally have glass made to any specifications; but Nature herself hinders him. Lead and lime glass are so called because the one contains lead oxide and the other calcium oxide. Some silicate (as sand or quartz) and some such alkali as sodium, potassium or Glauber's salt are used in both. Now, the more silicic acid and calcium oxide that are present, the greater the resistance of the glass to atmospheric influences. But these substances, upon being increased in relative quantity, add to the infusibility. It is difficult to produce a hard and resistive glass that shall at the same time be pure. All increase in the alkaline content gives added fusibility, but it lessens the resistance to the air. Because of considerations of such character, the manufacturer takes a middle course.

Glass melts in the neighborhood of 2,700-2,900 degrees Fahrenheit. This is a considerable temperature, and the manufacturers are understood to resort, generally, to the Siemens regenerative system in the construction and operation of furnaces. A proper mixture of sand, calcium, and alkali is thrown into a red hot crucible. The mass immediately boils and ferments, carbon dioxide being evolved out from the seething liquid. From 18 to 30 hours is devoted to the melting. When the melt cools to a fairly low temperature, it is found to be viscid and suitable for manipulation.

Spectacle glass is ordinarily formed first in the shape of big cylindrical shells. These are cut parallel to the axis, reheated in a special oven, and then flattened upon a table with the aid of a long rod manipulated by the hand or with the assistance of some equivalent means. Next, the flat sheet goes into an annealing oven where it cools off by slow degrees. The thickness of the sheets is controlled by the amount of soft glass that comes away with the long iron tube when the latter is withdrawn from the molten mass in the crucible. Uniformity of thickness is another matter and requires skill and experience on the part of the glass blower.

Spectacle glass must naturally be clear. It must also be uniform and must possess such a degree of hardness as not to scratch. The resistance to air must be good. The fumes from concentrated muriatic acid when applied to glass afford a recognized test for excellence of quality, especially with respect to air-resistance. With lead glass, the crucible is covered, for the reason that otherwise the contact of the furnace gases with the lead results in a discoloration of the glass. In general, modern glass furnaces are heated exclusively by gas, this gas being made from coal, wood, or some other suitable material. If colors are desired, they are obtained by the addition of the proper metallic oxide to the molten mass. Cobalt oxide produces blue; chrome oxide, green; copper oxide, blue-green; but copper protoxide,

(*Continued on page 114*)

## Learning by Seeing

By George H. Dacy

MAKING practical application of the "Seeing is believing," slogan, the Bureau of Commercial Economics, Washington, D. C.—the greatest distributor of educational motion picture film in the world—is, at present, rotating its film resources of 35,000,000 feet of negative contributed by thirty different countries so that the pictures are exhibited to 2,000,000 people every twenty-six days. The ramifications of this unique organ of education are now so numerous and world-wide that it is possible to provide all portions of the globe from the frigid Arctic Circle to the plains of Senegambia and the steppes of Russia through 3,600 distributing cities with a change of "movie" film every week, supplied from over 100 film exchange centers operated by the organization.

The Bureau of Commercial Economics is an altruistic association which utilizes the facilities and instrumentalities of governments, manufacturers and educational institutions in the universal dissemination of useful information by the graphic method of motion pictures which are always displayed to the audiences free of charge. The free "movie" shows are held at universities, colleges, technical and agricultural schools, public libraries, state armories, community centers, state granges, settlement houses, missions, chambers of commerce, boards of trade, rotary clubs, fraternal institutions, welfare clubs, factories and wherever the people are interested and crowds can be assembled. Thirty-six specially equipped motor trucks provided in each instance with a powerful projector, an electric generator, a field phonograph and a collapsible screen are operated in carrying the motion pictures to the rural communities both in America and foreign countries.

Educational films—supplied by industrial, scientific and commercial enterprises as well as by the railroads—which portray every conceivable operation from controling a forest fire to making an automobile, from manufacturing pins to building locomotives, are distributed. Films are sent at regular intervals on dog sleds from Newfoundland to the Arctic Circle over a route which covers 2,100 miles. By means of portable projectors and small lighting generators, the Esquimos, lumber jacks, fishermen and prospectors of this northland country are regularly entertained—often in the ice-built huts of the natives or the crude shelters of the whites—with motion pictures which bring the doings of the outside world to these pioneering peoples.

Primitive carts drawn by oxen are used as the means of transportation in conveying the films and motion picture machines to the inland villages of the Dutch East Indies, while throughout the Orient the camel is occasionally harnessed as the beast of burden to carry the current events as depicted in pictures to the various tribes and creeds of the desert. The Hindoos of India enjoy the same "movies" which delight the natives of Peru, Chili and Bolivia; these get the applause of audiences of Inca and Hopi Indians as well as those of local assemblages in every state in the United States and every province in Canada. To Australia, South Africa, China, Japan, Russia, England, France, Italy, Denmark, Sweden, Norway and to every quarter of the earth where the motion pictures have

**An ingenious arrangement of gimbal rings and heavily-weighted pendulum serves to keep the motion-picture camera on an even keel**

penetrated, the "teaching-by-eye" films of the Bureau of Commercial Economics are now disseminated.

For a period of eighteen years, Dr. Francis Holley, formerly a builder of trans-continental railroads, was blind, due to paralysis of the optic nerve. During this time he traveled all over the world, visiting various eye specialists in hopes of regaining his vision. Ultimately he decided if ever his eyesight were restored that he would devote the balance of his life to making the world at large see things. Finally, by the use of high frequency electric current treatment, Dr. Holley's vision was restored, although as a consequence of the electrical treatments his lower limbs were paralyzed. He has made good his vow to carry visual education to the masses, he being responsible for the organization and success of the Bureau of Commercial Economics.

Nearly a score of years ago, Dr. Holley conceived the plan of teaching industrial workers concerning complicated operations in their respective factories by the use of films. Under his direction the first educational motion picture ever made was filmed in one

(*Continued on page 116*)

## Keeping the Camera on an Even Keel

By J. E. D. Meador

DESIGNED to overcome the effect of the camera's tilting while taking motion pictures on a ship's deck at sea, which makes the skyline appear to rise and fall, a device patterned after the marine gimbal has been constructed and employed by a motion picture company with excellent results.

The accompanying illustration clearly depicts the new idea. The camera resting on aluminum gimbals and, equipped with ball bearings, may be turned completely around without moving the tripod. The legs are made of 1⅜-inch steel tubing, the lower ends being fitted with adjustable pointed tips. The pendulum, an iron ball, with auxiliary weights, suspended by 1½-inch pipe, measures 34 inches in length. The ball and weights aggregate 150 pounds. To facilitate carrying, the ball has a cross pipe through it to serve as handles. With camera loaded the complete outfit weighs about 250 pounds. The tripod legs can be adjusted to give the camera an elevation of ten feet.

The gimbals were manufactured in New York from plans and embody several new ideas. A severe test that included exposing several hundred feet of film, while the camera was vigorously rocked, proved the device a success. The designer has taken steps to secure patents covering the most important improvements embodied.

## Telephoning in Cipher

EVERYONE probably has felt an uncomfortable fear, at times, that a private conversation over the wire was being listened to by an unbidden and unwelcome third party. Such listening in, in fact, is quite possible even on a private wire and many are the instances where information thus gained has figured in divorce courts, criminal cases, or the game of politics. In time of war, of course, such betrayal of guarded secrets may become a matter of life or death. Various methods have been employed for preventing such leakage. One that has been recently made known is the invention of a young French physicist, M. Poirson, attached to the laboratory of General Ferrié.

When vibratory currents are interrupted audition is greatly interfered with. In making experiments suggested by this fact, M. Poirson obtained surprising results. He found that if the current be interrupted with a frequency varying from 100 to 125 the voice is altered, becoming harsh and strident. When 125 to 170 interruptions are produced one hears a little better. With 210 to 270 interruptions the voice is once more greatly altered, but beginning with 290 interruptions communications are much better heard. These experiments suggested to the investigator the idea of replacing the interrupter by an inverter of the current. Rapid inversions modify the harmonic composition of telephonic currents and currents thus deformed become absolutely unintelligible over the telephone along the entire length of the line, producing upon the ear the impression of some weird unknown language. At the receiving end the telephonic currents thus interfered with are reëstablished in their normal order by inversions which are identical and synchronous with the former ones. The apparatus has been named the cryptophone.—By *M. Tevis.*

**1. A movie outfit in the Arctic Circle that travels a circuit of 2100 miles. 2. A motor-truck picture show that was exhibited to 65,000 people in one evening at Washington. 3. Interior of one of the motion-picture trucks, showing phonograph, generator and projecting machine**

**The perambulating film that educates while it interests**

Copyright, Morris Rosenfeld

**Start of first race. Photograph taken from Committee Boat at one end of starting line**

# The America's Cup Races

## Notes on the Contests for 1920

### By J. Bernard Walker

MANY people who witnessed the present series of races for the America's Cup have asked why the yachts did not sail "boat for boat," instead of one having to make the other the enormous allowance of over seven minutes—a handicap which would represent, at the maximum speed of these craft, nearly a mile and a half of distance.

The practice of granting time allowance to a smaller boat was long ago recognized as necessary for the encouragement of yacht racing. For size means speed, and, boat for boat, unless there is something radically wrong with the design, the larger craft will beat the smaller. So, gradually, a system of handicapping grew up, in which time penalties were imposed upon either waterline length, or beam, or draft, or sail area, or upon various combinations of these elements; and efforts were made to formulate a rule which would be so nicely adjusted as to give the smaller yachts an even chance of picking up a fair share of the cups in a season's racing.

It is because Herreshoff in designing "Resolute" aimed to produce a small, fast boat, and Nicholson in "Shamrock IV" aimed at a faster big boat, that the "Shamrock" has to carry the burden of a seven-minute handicap. The official measurements show that she has about 20 per cent more sail area—she pays about 5½ minutes for that. She is of a fuller form in the overhangs and is more than half an inch overdraft, and another minute and a half, more or less, of penalty is paid for these.

But, outside of the penalties imposed by the rule, there are others exacted by the inexorable laws of nature. For the official measurements show "Shamrock" to be some six tons heavier than "Resolute"; and it takes but a glance at her profile and midsection to see that her total wetted surface is far greater than that of the smaller boat—possibly as much as 15 per cent greater.

Now it takes a certain amount of power to carry that six tons of extra weight around a thirty-mile course, and it takes a large amount of power to overcome the skin friction of that 15 per cent excess of surface in contact with the water.

So it will be clear, we think, that in addition to the seven minutes handicap imposed by the rule, the "Shamrock" carries a self-imposed handicap, due to greater weight and wetted surface; elements that are inherent in the design.

Since the extra weight of "Shamrock" is comparatively negligible in its consumption of power, the question resolved itself into one of whether "Shamrock's" big sail area could beat "Resolute's" small wetted surface plus "Resolute's" big time allowance.

Thus far, the races that have been sailed indicate that in 30 miles of reaching "Shamrock" might save her time; that in 30 miles of running she would be beaten by two or three minutes; and that in 30 miles of windward work she would be beaten boat for boat by four minutes, or eleven minutes corrected time.

These estimates are based upon close personal observation of the two boats in the three races which have been sailed at the present writing; and it is scarcely necessary to add that the weak point of the challenger, in a comparison with "Resolute" is her windward work. Whether close-handed, reaching or running, she foots faster; but when sheets are tightened in for a turn to windward, "Shamrock" does not point so high, and though she foots faster, she does not pull out far enough to compensate for the leeway.

Whether the difference is due to a certain lack of balance in "Shamrock," or whether the ocean swell which has been prevalent so far, and has caused her flat forward overhang to pound heavily and throw her head off to leeward, is an open question. Probably she would show better windward work in a calm sea.

In the first race (15 miles to windward and return) the wind was fluky. "Resolute," however, demonstrated her superiority in windward work; but just before she reached the outer mark, her throat halyards parted, putting her out of the race. As these races are considered by the Cup Committee to be a test of good construction as well as of speed, the first race went to "Shamrock IV."

In the second race (triangular, 10 miles to the leg) the boats made a good fight of it in the light wind until near the first mark. Here "Shamrock" ran into a calm, while "Resolute," to windward, sailing in a favorable streak of wind, turned the mark and pulled out a lead of several miles before "Shamrock" found the same breeze. This race was called off because of the expiration of the time limit.

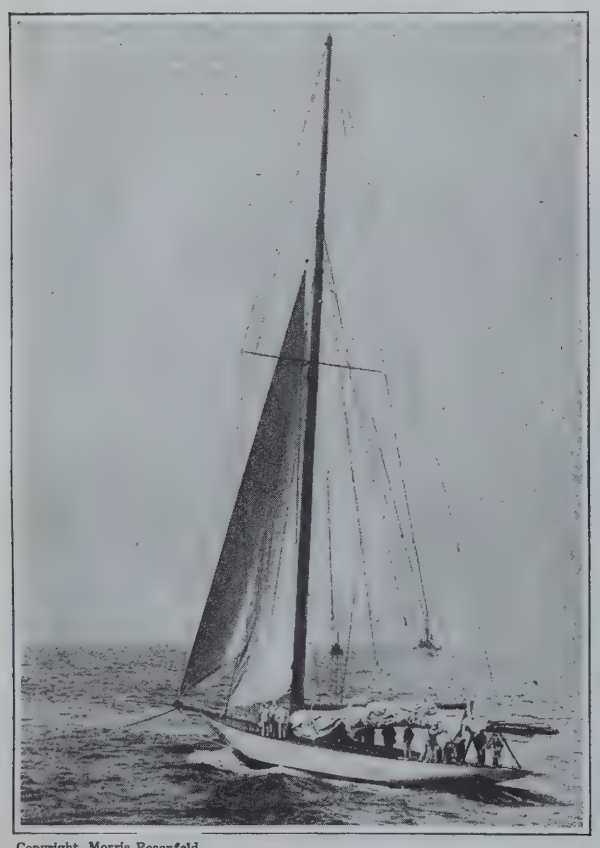
The third attempt was a race. "Shamrock" having the weather berth, carried a better wind, and this, coupled with excellent handling by Mr. Burton, put her around the first mark about 3½ minutes in the lead. In reaching to the second mark she gained another 5½ minutes, and she added one more minute in the ten-mile run, with spinnaker, to the finish, winning by 9 minutes 27 seconds actual and by 2 minutes and 26 seconds corrected time.

In this race "Shamrock" showed herself to be very fast in light weather with sheets started.

The situation now looked rosy for Sir Thomas Lipton. To win, "Resolute" must take three straight. If she lost a race, the cup, after 69 years' absence, would return to British waters.

The four races, finished or attempted, had been sailed in light airs—it remained to see how the boats would compare in a good, steady, wholesail breeze. The opportunity came on Wednesday, July 21, over a windward and leeward course of 30 miles. The predictions of those who had witnessed the earlier races were fulfilled. "Resolute" pointed higher and "Shamrock"

(*Continued on page 116*)



Copyright, Morris Rosenfeld

**First race: "Resolute," leading, carried away throat halyards and was towed home**

**"Resolute" about to round second mark in triangular race, which was unfinished for want of wind**

# The Heavens in August, 1920

## The Mechanism of the Tides, and How Their Heights and Times Are Predicted

By Professor Henry Norris Russell, Ph. D.

MANY of our readers who are living for the summer, at least, beside salt water—as is the present writer—have doubtless been more or less careful observers of the tides and their phenomena. The main facts are so familiar to us that we hardly realize how remarkable they seemed to the Greeks and the Romans. Accustomed only to the almost tideless waters of the Mediterranean, those travelers of classic times who went so far afield as the shores of the Persian Gulf or the English Channel were amazed to see the waters retreat, sometimes for miles, across the sandy or muddy flats, and return, a few hours later, to fill all the space that they had left bare. They soon learned from the inhabitants of these coasts, and confirmed by their own observation, that these successive high tides came a little more than twelve hours apart, so that on each successive day the high water was about an hour later; that the low water came about half way between the high tides; that on and about the times of new and full moon the tides rose unusually high, and fell exceptionally low; and that when the moon was in her first and last quarters they neither rose so high nor fell so low as usual.

At about this point knowledge remained stationary for many centuries, through lack of any proper understanding of the cause which lay behind the strange change in the level of the sea. It was indeed clear that the moon must have something to do with the matter; but the nature of the connection necessarily remained unknown until Newton, by his discovery of the laws of gravitation and of mechanics, illuminated this very dark place.

Everyone knows now, of course, that the tides are caused by the attraction of the moon upon the waters of the sea; and most of us know too that the efficient cause is not the whole attraction of the moon, but the difference between the moon's attraction upon the whole solid mass of the earth and on the water of any given part of the sea. These two forces are not equal in amount or parallel in direction; and hence there is usually a small differential effect, which tends to tilt the otherwise level surface of standing water, now in one direction and now in another. In a small circular pond of still water, the level would rise at the side nearest the moon, and fall correspondingly on the other side, provided the moon was above the horizon—otherwise it would be highest at the side opposite the direction of the (invisible) moon. As the moon swung around the sky from east to west, the high tide on the edge of the pool would follow it. It would be highest when the moon was 45 degrees above or below the horizon, and would disappear when the moon was rising, setting, or directly overhead or underneath. It is not worth while, however, to look for such tides in a garden pool, for the greatest rise of the water in a pond 200 feet in diameter would be about one ten-thousandth part of an inch. By using long lines of pipe, buried in the ground and half full of water, Professor Michelson has succeeded in getting rid of the disturbances due to wind and weather, and measuring these changes in level with surprising accuracy.

### Little Tides and Big Ones

In a lake 200 miles across the tide would rise half an inch above the mean level and fall as low, giving a range of an inch. Tides of this sort have been detected in the Great Lakes by taking the average of readings of the water level on many days, at the theoretical time of high and low tide, and so eliminating the effects of wind and weather, which quite overwhelm the minute tides on any given day, but "average out" in the mean of years of observation. In the land-locked seas like the Mediterranean the tides are of much the same nature, and have a range of but a few inches, except in a few abnormal regions.

In the great oceans the effects are larger and far more complicated. The oceans cover such large parts of the earth's surface that the tidal forces acting on different parts of them at the same time are quite different, and the continuous changes due to the rotation of the earth add to the complications. Even so, the time and height of the tides might be predicted, if the ocean basins were of uniform depth and regular shape; but they are actually so irregular in form and depth, and so much obstructed and cut up by continents and islands, that a complete mathematical discussion of the motions of their waters is hopeless.

This much, however, we know. The moon comes back to (approximately) the same position, as seen from any given spot on the earth's surface, at regular intervals of 24 hours and 51 minutes, which we may call lunar days. At any given part of the ocean, therefore, the tidal forces due to the moon repeat themselves at this interval—running through their changes twice, once when the moon is above the horizon and once when she is below. The rise and fall of the tides must necessarily follow suit, and so the waters of the ocean will be set swinging, rising and falling twice in the interval of a lunar day. These oscillations are very similar in character to those that may be set up in a tub of water by raising one edge slightly at regular intervals, and, as in the simple case, the water rises in some places and falls correspondingly in others at the same time. If the period of the "impressed force" is very nearly that in which the water would naturally swing back and forth from one side to the other—whether of the tub, or of the ocean if left to itself—a small impulse, often repeated, may build up a very considerable oscillation of the water.

The tides therefore have a much greater range in some parts of the ocean than in others, and the time, as well as the height, of high water will vary from place to place; but the *interval* between successive high waters will be always exactly one-half of a lunar day.

The sun also gives rise to tidal forces, but owing to its great distance these are less than in the case of the moon and the corresponding solar tides are of smaller range. The interval between successive high waters for the solar tides is of course exactly twelve hours. They will therefore alternately get in step with the lunar tides, reinforcing these, and out of step, partially counteracting them. The former of these effects will evidently occur at the time of new moon, when the sun and the moon are close together in the heavens and are pulling on the sea in the same direction. It will also happen at full moon, when the solar tide has gained half a day on the lunar tide, and reinforces the other high water. At both these times, therefore, we get the spring tides, of large range; while midway between, at the quarters of the moon, we get the smaller neap tides.

### Further Complications

The principal characteristics of the tide are thus explained. To make predictions for any given port, we must find by observation at what hours of the lunar day (measured from the moon's meridian passage) the lunar tide is high and low, and how great is its range; and also, by comparing the spring and the neap tides, what is the range of the solar tide and at what hour of the day it is high. We may then proceed to predict the tides in future for this port, and should get fairly good results.

For example, the distance of the moon changes during the month, being five or six per cent less than the average when she is in perigee, and correspondingly greater in apogee. The tide-raising force varies inversely as the cube of the distance, and so goes to fully fifteen per cent on each side of the mean, being greatest at perigee. The height of the lunar tide changes correspondingly, and the time of high tide is also influenced, since the lunar days are longer than the average when she is in perigee and moving fastest in the sky, and are shorter near apogee. These effects can be represented by superposing upon a uniform lunar tide of the average range, another tidal oscillation also of uniform height but of period a little longer than the first, so that it gets into step with the other and reinforces it every time the moon comes to perigee, and is out of step with it and diminishes its influence half-way between, when the moon is in apogee.

Again, the two high tides of the same day are not always equally high, nor the low tides equally low. The reason for this is that when the sun, for example, is far north or south of the celestial equator, his altitude above the horizon at any given hour of the day will not be the same as his depression below the horizon at the corresponding hour of the night. The tidal force in the two cases, though nearly in the same direction, will be unequal in amount, and one high water will be higher than the other. Exactly similar effects occur in the case of the moon, and we have a "diurnal inequality" in the tides. This may be represented by combining with the principal solar tide, of period half a day, a subsidiary tide of period a whole day, which, for example, is always high at the time of one of the semi-diurnal high tides, increasing this, and low at the time of the other, decreasing that one. The lunar tides are treated in the same way. And to account fully for all the changes in the tidal forces, a good many more of these minor oscillations must be added—most of them, however, small.

If the height of the tide has been observed at a given port, at regular intervals—preferably every hour, by some automatic gage—for a year or so, it is possible to disentangle from the records exact information regarding the heights and phases of each one of the twenty or thirty minor tides (each one recurring with exact uniformity), whose combination represents the actual situation. By calculating the height of each of these tides, and adding them all up, the actual course of the tides can be predicted years in advance with surprising accuracy. This would be an appalling task if it should be attempted numerically; but it can be done mechanically by a very ingenious and complicated machine which only requires to be set suitably at the start in order to run off a curve on a long slip of paper which shows the whole course of the tides for a year. Such a machine is used by the Coast Survey in preparing the tide tables which they publish for the

(*Continued on page 116*)

At 11 o'clock: Aug. 7.
At 10½ o'clock: Aug. 14.
At 10 o'clock: Aug. 22.

At 9 o'clock: Sept. 6.
At 8½ o'clock: Sept. 14.
At 8 o'clock: Sept. 21.

At 9½ o'clock: Aug. 29.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

**NIGHT SKY: AUGUST AND SEPTEMBER**

# The Service of the Chemist

*A Department Devoted to Progress in the Field of Applied Chemistry*

Conducted by H. E. HOWE, Chemical Engineer

## Water-Resisting Casein Glue

RESULTS from a series of experiments undertaken at the Forest Products Laboratory under the auspices of the Army and Navy have now been made public, and the casein glue, which has been developed there for airplane construction, should find rather wide application in industry. It has been determined that formaldehyde, sometimes used to coagulate casein, is not successful in rendering the product less soluble. All caseins, if reasonably pure, can be made into satisfactory glues, using the same formula but varying the amount of moisture. The most essential constituent used in casein to produce the water-resisting glue desired is lime, but the purity of the lime is not a determining factor. It is desirable, however, to use lime of known analysis and in employing new raw materials, tests of the water-resistant qualities of the glue produced should be conducted.

Casein is combined in its natural state with lime, from which it is freed by precipitation from milk, skimmed milk being the best source. The casein is not soluble in water, but is made into a paste with a solution of caustic alkali, and when the mixture dries, it is insoluble in water. Proof of the value of casein glue, as well as animal, vegetable and blood albumen glues, has been shown by subjecting samples to the action of gasoline, engine oil, and castor oil for twenty weeks, after which no separation of the plies was evident.

Complete information on this subject in the Technical Notes of the Forest Products Laboratory.

## Ang-Khak

ANG-KHAK is a red rice which is the source of a common vegetable color used in Chinese food products. The color is produced by certain strains of a mold, which spreads throughout specially treated rice kernels. The same fungus has been found in American corn, in silage, and is accountable for "freckled" salt fish. The finished Ang-khak is composed of clear-cut grains of a dark red color, which may be easily reduced to a fine, soft, red powder. The mold must be grown under controlled conditions, with particular attention to water content, which, if incorrect, will produce a grain which splits into fragments rather than breaking down to a powder. It is necessary to select proper strains of the mold, *monascus purpureus.*

## Tunnel Atmosphere

THE Bureau of Standards has been requested by the New York and New Jersey Vehicular Tunnel Commission to undertake an investigation of the atmospheric conditions which would be likely to exist in such a tunnel as is projected to connect Manhattan Island with New Jersey. In this study particular account must be taken of the exhaust gases from motor vehicles, in which, as is well known, carbon monoxide is to be found. Road tests have been begun with some eighty motor vehicles of different classes, and the results obtained from these tests differ somewhat from the block tests which have heretofore been conducted. In the near future a series of chamber tests on human subjects will be started and these chambers will be designed to represent cross sections of the tunnel as it is now designed. Inasmuch as there are similar tunnels under consideration for other cities, the work in question assumes increased importance.

## Empire Cotton Growing

IT will be enlightening to those interested in cotton to follow the efforts of the British Empire Cotton Growing Committee in increasing the supply of suitable grades of cotton fiber. The committee is of the opinion that within the British Empire both the quantity and quality of cotton required can be produced, and it is toward Egypt and the Sudan that they look for the most immediate large increase in the production of cotton. The African continent is looked upon as most promising, but before any considerable area can be brought into cultivation, large sums must be expended on irrigation, drainage, railways, water-ways, roads, and harbors. There is also need for greatly increased staffs of agricultural specialists and government control of seed supply, as well as of measures to combat insect pests. At this time, when the possibility of establishing an American Institute for Cotton Research is under consideration, it is well to note that the Empire Cotton Growing Committee places a central institute, in which all the sciences relating to cotton growing may be studied, as one of their first recommendations.

It may be that the time has come when much of the tropical and semi-tropical land may be brought under cultivation, for whereas this development could not go forward when the horse had to be depended upon as the only power for cultivation, the condition is changed by the advent of the modern tractor. The motor is also capable of bringing the crop to the avenues of travel, and in all of these agencies for the spread of civilization and increased production, chemistry has played an important part.

## Specifications for Basic Sulfate White Lead

CIRCULAR No. 85 of the Bureau of Standards has been issued, being a specification for basic sulfate white lead, prepared by the inter-departmental Committee on Paint Specification Standardization. With the various departments interested there were associated representatives of the Paint Manufacturers' Association of the United States, and prior to the publication of the specifications, a number of paint and varnish makers, including all of the large manufacturers of white lead, were asked to comment upon the poposed requirements.

The specification gives chemical and physical requirements of dry basic sulfate white lead and basic sulfate white lead ground to a paste in linseed oil. Methods of sampling and methods of testing both dry pigment and the paste are part of the specification.

## Energy Requirements

A WEEKLY news letter of the U. S. Department of Agriculture states that a family, consisting of a father, mother, and three children requires approximately 12,000 calories per day, and that the diet is best balanced by considering 120 units of 100 calories each. On this basis, fruits and vegetables should supply 24 units; milk, eggs and meat, 36; cereals and legumes, 30; sugar and starchy foods, 12; fats and fatty foods, 18.

## Desiccated Vegetables

DR. HAWK, of the Jefferson Medical College, points out that when desiccated vegetables are immersed in water for a few hours they assume a form very closely approaching that of the fresh vegetable, and that if this rehydrated material be removed from the water and left at room temperature for 24 to 36 hours it returns to approximately the same anhydrous state as before being freshened. This is an entirely different behavior from that observed in fresh vegetables, and the conclusion is reached that there must be a structural difference. The failure of the re-hydrated product to retain its water may be due to the change in the colloids of the vegetable cells, with an accompanying decrease in their power to hold water. The decrease in the inhibition power of the colloids might be due to the removal of mineral salts from the vegetable during soaking in water. These experiments have no reference to nutritive values.

## Physical and Chemical Properties of Copper

AT a recent meeting of the American Institute of Mining and Metallurgical Engineers there was a discussion of the relationship between the physical and chemical properties of copper, particularly with reference to the indication of chemical composition which certain physical characteristics indicate. Thus the appearance of the surface of the copper when cooled is termed its "pitch," which is the general contour of the surface of the shape, and this may vary from concave to convex. When the surface is concave, it is called a low pitch, and a convex surface is a high or tough pitch. A level surface is called a flat pitch. In the trade they go further and designate as the "set" the detailed appearance of the surface, that is, wave-like structure, and high pitch copper is usually described in terms of the set. If the set is very close and even, the copper content is about 99.95 per cent, and this same close set cannot be produced on a shape of low pitch.

Good electrolytic copper should have the following analysis, approximately: copper, 99.95; silver, 0.001; oxygen, 0.039; sulfur, 0.003; arsenic, 0.0015; antimony, 0.0020; nickel, 0.0015; iron, 0.0025; lead and bismuth, nil; selenium and tellurium, trace.

## Standard Materials

THE verification of analytical methods, the standardization of calorimetric work, and the determination of melting-points and similar scientific work depend very largely upon standard materials. For some time the Bureau of Standards has made a practice of supplying many thousands of samples annually, embracing iron, steels, ores, and organic compounds, upon which a great deal of work has been done, and with each a certificate was furnished for the guidance of those who depend upon them for their standards. This work has been made possible by appropriations, but the sale of samples has returned to the United States Treasury a larger sum than it has cost.

We have then a unique case, in that the work, besides being of fundamental importance to industries and educational institutions, is also self-supporting. It has been somewhat of a shock, therefore, to note that the House Committee on Appropriations has failed to provide any money for continuing this work, whereas a somewhat larger sum had been requested in order to extend this important activity. The failure to make suitable provision must be due to a lack of appreciation as to what these standard materials mean to industry, and it is hoped that active steps can be taken to insure the restoration of the item in question.

## Ceramics

DURING the recent meeting of the American Ceramic Society 131 papers were presented and many of these report results of scientific studies on the several problems peculiar to the various divisions of the Society. The field embraces enamels, glass, refractories, terra cotta, white ware, porcelain and kilns.

The point was made in some of the discussions that the day when scientific work was unappreciated in the industry is rapidly passing, and those with foresight have already set up their own scientific organizations. There are a number of problems, however, so fundamental that it seems worth while to attack them through some coöperative effort. The Glass Division passed a resolution to appoint a committee which will coöperate with the National Research Council, Division of Research Extension, for the purpose of canvassing the field. This committee will consider first, the problems which are suitable for such a study, choosing from the number a few to comprise the initial program; second, the facilities available for the work; third, the personnel having suitable training and experience; and fourth, a proper plan for financing the undertaking.

A Glass Research Association has already been formed in Great Britain and work there has actually been done. It is hoped that the movement which has started here will make rapid headway.

## Forging Iron-Nickel Alloys

IT has been established that pure iron-nickel alloys do not forge satisfactorily at ordinary forging temperatures, and at the Westinghouse Research Laboratory an investigation has been under way to determine what treatment would make such alloys more readily forgeable. It has been found that aluminum, chromium, magnesium, and silicon have scarcely any effect, but that in amounts of two per cent of the lesser constituents, manganese or titanium imparts the desired characteristics and makes the alloys forgeable.

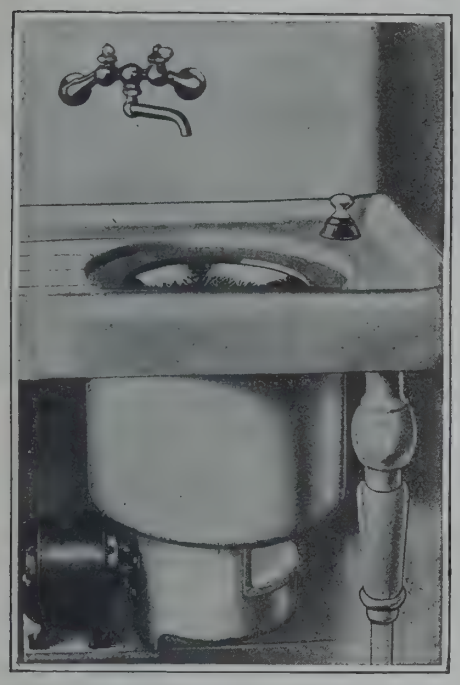
It is believed that these elements have the ability to strengthen the amorphous inter-crystalline material to the point where it possesses greater strength than the crystals.

## Coals for By-Product Coking

WHILE the chemist can make an accurate analysis of coal, it is not generally understood that such analyses cannot give results in terms of by-products from gas or coking operations. The chemist determines the elements which, under suitable conditions, combine to form ammonia, benzene, toluene, tar, etc., but he does not separate the coal into these substances. The amount of these by-products which will be produced depends upon many conditions, and indeed more upon the operation of the plant than upon the character of the coal. It is necessary to coke coal under commercial conditions and even a small-scale plant can do no more than indicate the possibilities so far as our present knowledge is concerned. In all this work the laboratory and semi-commercial-scale plant is a very valuable guide, but the limitations must be recognized.

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*



Dishes are washed in the sink by means of this washing device

### A Dishwashing Machine Right in the Sink

AN electric dishwashing machine which is built right in a porcelain enamel sink is a late product of a Chicago manufacturer. Power for washing dishes in this machine is derived from two perpendicular reels which throw the water with a tremendous force to the center of the bowl. The boiling water passes between every dish and flows off through the drain pipes. The dishes are placed in the machine in a permanent position and are not in motion during washing operations.

Any light socket or wall outlet will furnish the power to operate the ¼-hp. motor used with the combination machine.

### Locking the Shoes Outside the Hotel Bedroom

THE thief, so it seems, is always with us, no matter whether it be in the taking of automobiles, boats, jewelry, clothes or even shoes. Just now it is shoes in which we are immediately interested.

The practice in most Continental hotels is to place one's shoes outside the hotel bedroom door, in order that the bootblacks may clean and polish the shoes and return them by the next morning. But with the greatly increased price of shoes it seems that a new form of petty stealing has come into practice, namely, stealing shoes. So serious has this threat become that an English inventor has worked out an ingenious form of lock which appears in the accompanying illustration. It consists of a U-shaped member whose legs are pressed down into a pair of shoes to be locked in place. In this manner shoes may be locked outside the bedroom door with full assurance that they will not be stolen by the petty thieves engaging in shoe stealing.

Pushing down the U-shaped member locks the shoes in place

### Speeding Up the Camphor Harvest

DOWN in Florida and other Gulf States the camphor trees are cultivated in rows much the same as any other crop. Tillage is comparatively easy, but in harvesting the leaves and twigs the job becomes a tedious and expensive operation.

Heretofore the camphor-making material has been clipped from the tree by hand, which costly procedure doubtless is responsible for the advancing price of the product. But again the American inventor has come to the rescue in this all-important matter of reducing the high cost of production; this time it is the inventive skill of a specialist in the Bureau of Plant Industry, U. S. Department of Agriculture, that is responsible for a machine which strips the camphor trees of their leaves and small branches without injury to the limbs or impairment of the productive capacity of the trees. The machine, which is shown in the accompanying illustration, carries its own gasoline engine. As it is drawn between the rows of camphor trees, its cutting knife cuts off the leaves and small branches.

Hand work in harvesting camphor-making materials is done away with by this recently-introduced harvester

### War's Explosives and Italy's Agriculture

WITH a view to disposing of the surplus supply of explosives and at the same time benefiting agriculture, many experiments have been conducted by the Italian Ministry of War in connection with the breaking of ground. The results have been so satisfactory that it has now been determined to proceed to the practical use of explosives in agriculture on a large scale. In addition to preparing the land for cultivation, it is claimed that the use of certain explosives not only destroys parasites but also to a certain extent reduces the necessity for fertilization. It is proposed to establish in all districts of Italy demonstration fields where trials of the system which has been adopted will be carried out; such fields have already been created in Umbria, Puglie, Tuscany, and the liberated Provinces. At the same time, the Mininstry of War will turn over the large quantities of available explosives at favorable prices.

### Gluing Mandolin Backs by Machine

A NEW time, space and labor saving automatic drying and gluing machine has been invented by the foreman in one of the largest manufactories of musical string instruments in the United States, located at Jersey City, N. J. This new machine, as can be seen herewith illustrated, enables the operator to glue and dry hundreds of mandolin and guitar backs in a short time. Ordinarily a mandolin or guitar back is glued and put in a device which holds the two pieces together under pressure, and then placed on the floor to dry. Hundreds of these upon a floor, especially in a factory, take up lots of room and take up many an extra hour with operatives who are being paid for their time. With the invention of this new machine a general saving is made by the firm.

The machine is operated in the following manner: Place a glued back on one of the racks, which are found on the revolving wheel or machine. When the rack reaches you for the second time the back is both dried and glued thoroughly. Then you are in a position to put on another mandolin or guitar back for drying and gluing.

### A Turkish Bath for Milady's Hair

IT may be that one of the aftermaths of war is a most strenuous effort on the part of the fair sex to appear at its best. Those who are blessed with natural beauty seem to strive in every way to exploit their charms to the utmost, while those not so blessed strive a hundred-fold more energetically to acquire beauty in every possible manner.

However all that may be, the fact remains that inventors have been working on the problem of beauty with more than usual vigor. Numerous beautifying devices have been patented since the ending of hostilities, and more keep coming along week by week. All of which, to be sure, presages a genuine demand for such devices. The Turkish bath arrangement shown in the accompanying illustration is one of the latest devices along this line. It consists of a canvas hood, electric heater, and steam-producing arrangement. When the device is placed on the head and the current turned on, the hair of the patient is treated to a steam bath which, so we are told, is conducive to a wealth of beautiful hair.

This machine serves to glue hundreds of mandolins in a short time

### Peat Fiber and the Textile Industry

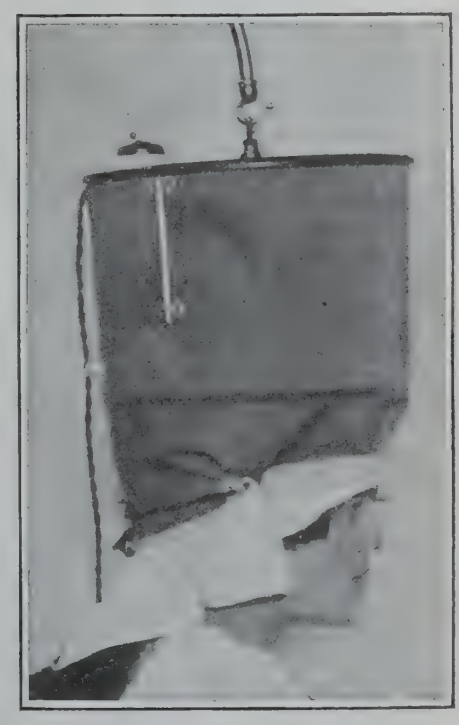
SWEDISH efforts to introduce peat fiber as a substitute article in the textile industry have come to naught for the moment. It is the consensus of opinion that the prices for extracting the fiber from peat moss must be economical before it will ever come into general use. Two factories, one in Denmark and the other at Partille, near Goteborg, Sweden, both established during the war for the purpose of utilizing peat fiber, have had to close their doors in recognition of this fact.

The experts appointed to make the investigation have completed their labors, and, among other things, found:

(1) Good textiles of peat fiber and "shoddy" can be manufactued and samples were demonstrated, but

(2) The Swedish peat mosses can produce only 100 kilos of fibers and moss per day, which is not sufficient for commercial purposes.

(3) The methods so far used in obtaining the fibers are too expensive.



This electrically-operated device treats the patient's hair to a Turkish bath

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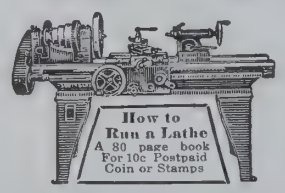


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## Our Future Oil Supply

(*Continued from page 102*)

barrels of oil a day settled production, more than our famous fields of Ranger, Desdemona and Cushing combined, with their thousands of wells. Against them all stands the peerless Cerro Azul No. 4 alone, with its depth of but 1,752 feet, and proudly outmatches not wells or even single pools, but groups of fields instead, keeping up an output which they can only maintain by means of the constant addition of new wells. During the first week when it came in that one well alone produced about one-sixth as much oil as all the wells in the United States together.

Then comes the Juan Casiano, with its output to the present of over 8,000,000 barrels and which still is producing at the rate of 23,000 barrels a day through a damaged valve, and the Portrero del Llano, which produced 100,000,000 barrels before it was drowned out by salt water. It flowed 46,000 barrels a day for years—a greater output than the entire Healdton field of Oklahoma—the casing being defective, and great seepages coming up through the ground for a radius of half a mile. Truly, Nature has been kind to Mexico!

A flood of oil like that set forth in these figures is hard to comprehend, and still more bewildering when translated into dollars and cents.

These wells are by no means alone. There are others that stand out as giants among the wells of the world. Two were brought in a short time ago with an initial or flush production of between 60,000 barrels and 80,000 barrels a day, the latter having a production almost as great as America's largest field—the well-known Burkburnett pool of Texas; and dozens of others run as high as many of our smaller fields. Indeed, a report places a recent daily output of three hundred and five Mexican wells at 1,925,233 barrels, or 6,312 barrels per well! An average of 200 barrels a well for an entire field is regarded as exceptional on this side of the Rio Grande. Mexico's total supply comes from but little over 300 producing wells, which have only been run irregularly; and yet these with their partial output produce annually the equal of 37,500 wells here, or approximately one-sixth as much oil as the over 225,000 wells in this country.

The Mexican fields are divided into three districts or zones. The heavy crude oil is produced in the "Northern Field," lying west of Tampico, and comprises the Ebano, Panuco and Topila fields, of which Panuco is the most prolific and Ebano the scene of the first gusher in Mexico. The oil is from 8 to 15 (Beaumé) gravity.

The "Southern Field," or the light oil district, begins at Tepetante, about 72 miles south of Tampico, and extends 36 miles to the south of the Tuxpam River. The oil is about 22 (Beaumé) gravity. It is here that the famous oil bearing Tamasopa or honey-combed limestone is encountered, which is stated to have a thickness of one or more miles, and which accounts for the wonderful capacity of the wells. This field was opened in 1910 with the great Juan Casiano and Portrero del Llano wells previously described.

The third zone is still farther south on the Isthmus of Tehuantepec, and is known as the "Isthmus" or "Tehuantepec" field. While the production at present is not as great as that of the others, the oil is of much higher quality, about 37 Beaumé, and vast stretches of probable oil territory in Tabasco, Campeche, Yucatan, Chiapas and Quintana Roo have not even been prospected. It is in this field that the Pearsons of London have their well known Salat well, and also their refinery at Minatitlan.

These three districts form the producing fields of Mexico today—starting with the low grade oil in the north and increasing in quality toward the south. The west or Pacific coast has not yet been developed for oil but portions of it look most encouraging, especially parts of the Pacific littoral of lower California, which the Mexican official reports designate as a petroleum-bearing region. Oil outcroppings are found there in several places and the geological formations give most favorable promise. The large companies are reported to have acquired huge domains in this section and geologists claim that some of the greatest deposits will be uncovered there.

In the eighteen years in which the writer has known Mexico he has never encountered anything but exceptional courtesy from her people, or other than utmost consideration from the government despite the fact that he has been there in most trying times.

Verily, Mexico is a land of riches. Nature has given her every available climate, elevation and geographical and topographical formation—a soil that in places is a marvel of production, fisheries of great richness, mines that produce gold, copper, antimony, etc., and for years contributed one-half of the world's supply of silver—and below lie the vast reservoirs of petroleum, which today have hardly been tapped and the possibilities of which have not even been explored. These fields now bid fair to see a campaign of development that will again startle the world and that will add untold millions to its wealth.

## Scrapping Good Machinery for Better Service

(*Continued from page 103*)

wires in a single cable and cables laid as late as 1916 contained circuits having 320 pounds of copper per mile. Today cables containing only 80 pounds of copper per mile are being used with better results. At the same time cables which were useful only for very short distances have been improved so that now conversations are regularly carried on over a thousand miles of cable. New inventions make it possible to talk from New York to San Francisco by cable with no more difficulty than was experienced only a few years ago in talking from New York to Boston on overhead wires. The present advantage of cables over wires is so obvious that this replacement is taking place all over the country just as fast as the new equipment can be manufactured. It is estimated that the saving to one company from this single change, ten years hence will amount to $5,000,000 a year!

Of course these two improvements in telephone service—the automatic connection and the cable—are largely an apparatus with which the average subscriber does not come in contact and about which he does not bother. But within the memory of nearly all of us, the telephone instrument itself has been replaced several times. It wasn't so long ago that we were talking into great cumbersome battery phones that hung on the wall, and were calling "central" by cranking a little magneto. This has evolved into the convenient desk phone of today. Each replacement has meant the expenditure of millions of dollars and the saving of many other millions.

Today there is a great engineering laboratory in New York employing 3,125 men and women, which has as its sole purpose the improvement of telephones and telephone systems. During the past year this laboratory has actually prosecuted work on more than five hundred improvements in the telephone art. All of these promise advances in the interest of service or economy. Many have reached the point where success is assured. Others will require many years of development before any practical results can be seen. Some of them look so visionary and unpractical that it seems a waste of money and time to carry them further. Yet thousands of dollars are spent on such things annually in this laboratory. And it pays!

It must not be inferred that the laboratories which are responsible for great advances in public service are an inventor's paradise or that every new invention wins instant recognition from a wizardly set of directors. The men who direct these laboratories are serious-minded scientists and engineers, who arrive at their conclusions after most thorough study and experiment. There is nothing haphazard about it and when a great advance is ready for practical application it has been calculated beforehand just what the saving will be and it has already been demonstrated on a small scale. That is why it pays.

## The Romance of Invention—XV

(*Continued from page 104*)

fessor Michelson, one of the greatest living authorities on such matters, happened along in time to express his interest and declare their genuineness to the discomfiture of Mr. Ives's critics.

Mr. Ives has been responsible for so many oddities in light, color and picture that a catalog would be almost wearisome. But it would be criminal to neglect to mention the binocular microscope which can be used with high powers as well as low, and for stereoscopic photomicrography under high powers Mr. Ives has made stereograms of small diatoms which, when viewed in a stereoscope, have the appearance of richly carved cut glass dishes. Any microscopist who has first found, then resolved, and finally studied these diatoms, famous test objects for fine lenses, will appreciate that a device which will make steographic photographs of them through an oil immersion one-twelfth at 1,700 diameters is worth mentioning here!

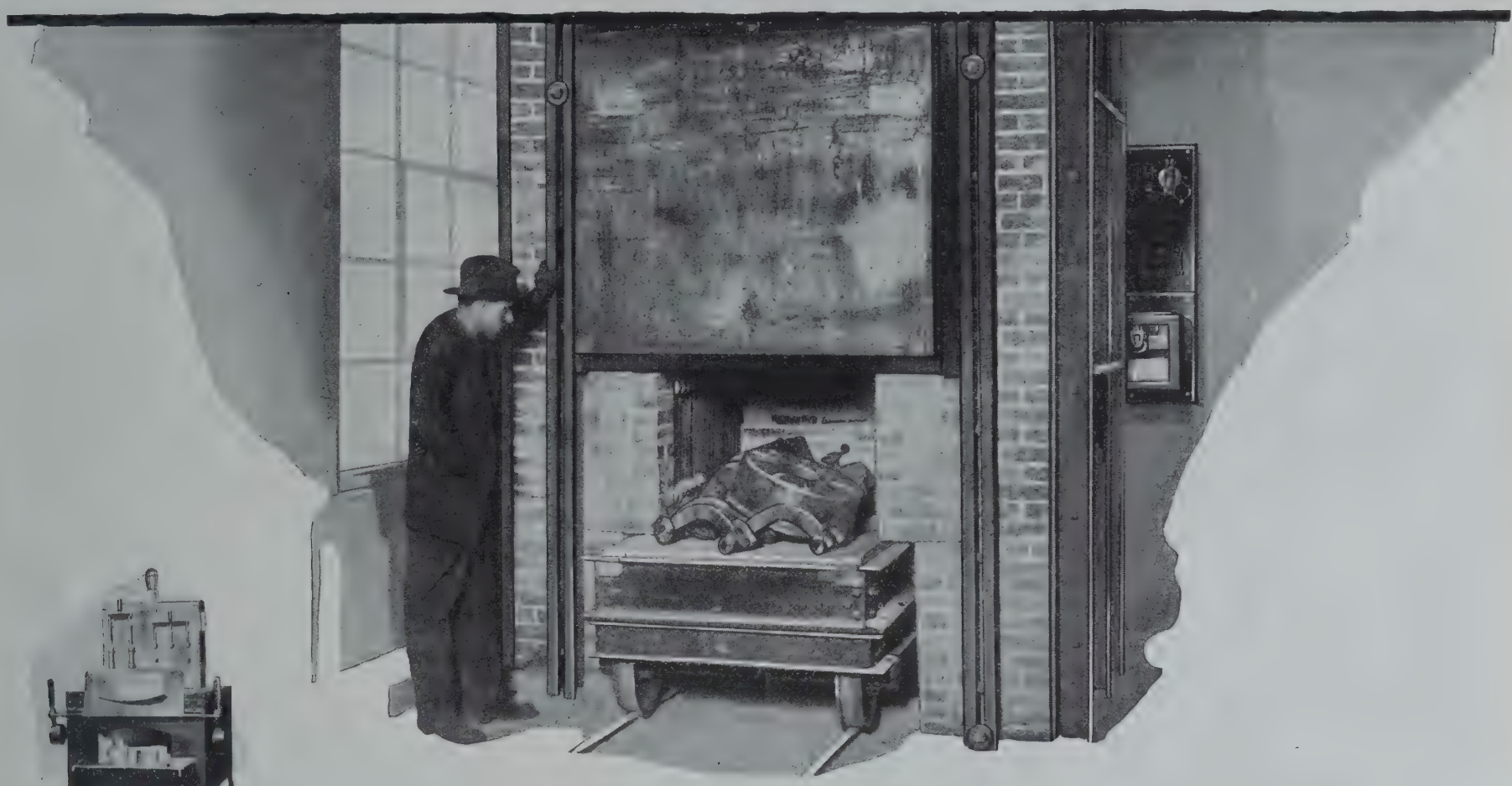
Mr. Ives was born in Litchfield, Connecticut, where his father first had a farm and then conducted a store. The young Ives started as a farmer boy and a store keeper. While in the store he took up amateur printing and at the age of 16 was a journeyman printer and amateur photographer by the old wet plate process of that day. He made his first camera out of a cigar box and spectacle lens and made good negatives with it. He then went to Ithaca and there, as a lad of nineteen, applied to Professor Anthony for the job of photographer in the University photographic laboratory. The learned professor would have none of him at first on account of youth and inexperience, but Ives persevered until he was allowed to try, probably as the easiest way of getting rid of him. He stayed four years because, as Professor Anthony said, before he came they had never been able to get such good work done.

During this time Mr. Ives endeavored to learn wood engraving, but without distinguished success. It was to substitute for the engraver's "V-shaped tool," a "V-shaped graver of light" that he went to work, the result being the familiar half-tone process. Worked out first as a photomechanical process and introduced commercially in February, 1881, in 1885 and 1886, the present-day half-tone screen system was developed from it and that process given the world which made the modern illustrated paper possible and revolutionized the printing industry. Incidentally, it may be mentioned that Mr. Ives has in his files a patent applied for in 1891 for the type of intaglio printing plate used in the present system of rotary photogravure, which illustrates in brown ink our familiar Sunday supplements.

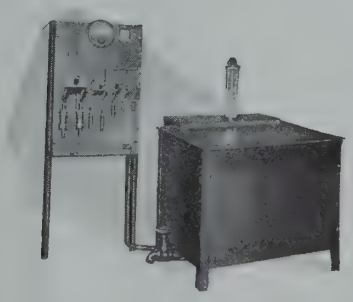
Following the half-tone process, the three-color process was Mr. Ives's work, and to his genius and knowledge of optics we owe that wonderful art by which colors as nearly natural as pigments can accomplish can be laid on paper by the printing press in thousands, even millions, of copies in a short time.

(*Continued on page 114*)

*Perhaps the surest proof that electric heat has graduated from the experimental class is the use of 1,000,000 kilowatts for industrial applications*



*Muffle type heat treating furnace*



*Electrically heated oil tempering bath*

*Core baking oven*

# A Furnace that can't get too hot

WHEREVER human life depends on pieces of steel for safety and strength, as in axles, wheels, gears and many other parts of machinery, the heat treating of those steel forgings or castings is all-important. Too much heat is just as bad as too little, and a few degrees either way is enough to make the steel unfit for its purpose.

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G-E electric heating equipments are made for furnaces of various sizes, for temperatures up to 1800° F., and are being used for heat treating, annealing, carburizing, and hardening metals, in many industries.

While equipping furnaces constitutes a large part of the General Electric Company's share in the development of electric heat, there are many G-E heating devices for other purposes. From the miniature cartridge unit which heats a soldering iron, to the monstrous oven which bakes enamel on automobile bodies, electric heat has established itself firmly, and has exceeded the fondest hopes of its most ardent exponent.

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## The Romance of Invention—XV

(*Continued from page 112*)

Mr. Ives, while freely crediting to another the principles of panchromatic photography, was the first to realize a successful process in commercial practice. His inventions also include a color meter—a device for measuring color and tints which has the possibility of more than one million variations, and of hundreds of variations of any one shade. Any color can be matched to the eye and expressed in simple numerical terms.

It must not be supposed from anything said above that Mr. Ives regards as impossible the making of color photographs on paper by a process so simple that any one can use it. His own "hichrome" process has been exploited commercially and does produce results which are beautiful and sincere. That it might be simplified is by no means, in the inventor's view, impossible. But he will tell an inquirer that inasmuch as nature provided three primary colors, which, by combination, produce the sensation to our eyes of all other colors, a less-than-three-color process does not appear feasible if it is to be truthful, and that wherever there are *three* negatives and *three* prints, which in one way or another must be presented as *one* to the eye, there must also be difficulties of manipulation and coördination that are apt to make trouble for the tyro. But he has by no means given up work either upon this or any one of a dozen other processes which he has and is working out, and indeed, is even now fitting up a new laboratory for the special investigation of color reproduction problems.

Mr. Ives believes that there is a great future for motion pictures in color, the colors of which will be nearly if not quite natural and which will be as much without flicker or mechanical or financial difficulties as the present black-and-white moving-picture films are; and he has high hopes of the commercial value of this, his latest contribution to the science of picture making.

That some one will make money out of it seems assured, even as millions have been made out of Ives's inventions by others.

"But I haven't time to make money," says Mr. Ives. "There is too much else to do."

Incidentally, it should be chronicled that America's foremost authority on the subject, who has been honored at home and abroad for his researches, his inventions, his papers and his knowledge, is *not* a graduate of any college and holds *no* degrees, probably for the same reason he hasn't made himself a fortune—he has been too busy making and perfecting inventions to have time!

## Our Mechanical Eyes

(*Continued from page 106*)

red; gold, ruby; silver, yellow; iron, greenish; manganese, violet. If a smoked effect is desired, it may be obtained by combining several of the foregoing oxides.

The spectacle sheets are gone over and many discarded for lack of the desired excellence in some respect or other. The sheets which pass inspection are now cut into circles or ellipses by a special machine which operates a diamond cutter.

Optical flint glass, which contains a good deal of lead, may be prepared by using pure red lead to supply the lead, or else litharge (the semi-vitrified protoxide of lead). A normal flint glass will result from the use of 3 parts of sand, 2 of red lead, and 1 of potassium. The great difficulty in the manufacture of optical flint glass centers on the elimination of bubbles, strains and striae. The lead tends to sink because of its considerable specific gravity, so that the mass must continually be stirred. The melting of the metal may last a number of days, so that the stirring is by no means an evanescent job. It is undesirable to have the iron rod in contact with the glass. A curious device is used in this connection. The long iron rod is retained. It is bent, however, at right angles on the end, and this arm dips down into a clay vessel of cylindrical form. The bottom is closed, so that the vessel floats deeply in the molten glass. By manipulating the rod, the vessel is made to do the stirring instead of the rod itself. When the viscid condition is reached, the mass is permitted to solidify. Ordinarily, the crucible is sealed and left in the oven, the two to cool off together. After solidification, the crucible is broken open and the apparently good pieces of glass selected for tests as to optical qualities. If twenty per cent of the melt is usable, the manufacturer will be well satisfied.

There are special optical glasses which do not come under the lead and lime classifications. Various substances, such as bromic acid, phosphoric acid, fluorine, zinc and barium, have been pressed into service. The old crown and flint glasses have been surpassed in respect to the desirability of the refractive indices of the best of the newer products. Glass has been made containing absolutely no silicic acid. These types of glass are the result of the labors of the last 30 or 40 years.

Lenses of the commoner forms have binary combinations of plane, convex spherical and concave spherical surfaces. But the diverging types produced thus by no means exhaust the varieties now made and used for one optical purpose or another. In short, it has been found that the foregoing types did not cover all the requirements of defective vision. Thus, binary combinations of a cylindrical surface with plane and spherical surfaces have been found to produce lenses of distinct value to eyes unresponsive to the older forms. There is another type which demands notice. The convex member at the base of the ancient and classic architectural column—the member shaped like a doughnut or a life buoy—is called a *torus*. From this we have the adjective *toric*. Toric lenses are those having one surface agreeing in form with the convexity of the ancient torus. It is as if one bent a cylindrical surface so as to convert the rectilinear lines, called elements, to circular arcs.

The ordinary elliptical lenses for spectacles and the like are made from rectangular blanks about 1.76 x 1.36 inches in size. This size is regarded as especially economical. From it may be cut all sizes. Cylindrical lenses may be made from blanks 1.68 x 1.68 inches in size. However, it has been found possible to grind the axes of cylinders diagonally and thus produce from the standard size of blank what is often a much larger lens than could otherwise be cut from it.

An automatic machine sorts the blanks for lenses, thickness being the basis of separation. The various blanks are thrown into receptacles devoted to the several gages of thickness, the work being done so accurately that the error is below 0.01 inch.

The grinding of the blanks is accomplished by one large concern in the following manner: Warm pitch is employed as a thick surface coating of the grinding block. In this are placed a lot of the elliptical blanks. The block is given its covering of pitch by being pressed into a mold into which hot pitch has previously been poured. The block itself is preheated to facilitate matters. Upon cooling off, the block is withdrawn and the lenses, having in the meantime been heated on hot tables, are placed upon certain projections but in the layer of pitch. The block and its charge of blanks are now allowed to cool off, the pitch hardening and securing the blanks firmly in their respective positions.

The blanks are now ready to be ground. The block is set in place on the spindle of the grinding machine. That is, the exposed glass surfaces are now ground

(*Continued on page 116*)

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## Our Mechanical Eyes

(*Continued from page 114*)

against a spherical surface which forms the inner surface of a bowl. The abrasive material is emery powder or an equivalent. The larger grain sizes are first employed and then the smaller ones.

The next machine operation is that of polishing. Before or during this procedure, scratches may be discovered on the ground surfaces of the lenses. If so, the block must be ground again, as the removal of actual scratches is not a job for the polishing machine. A block with its complement of lenses perfectly ground is now set in or on a fixed holder in the polishing apparatus. The polisher rotates over the block polishing the various lenses by means of fine polishing material. The polisher is a shell having the same curve as the block and containing a lining of heavy felt which is cemented to the shell. The curvature of the block is vital and must be maintained. In hot weather this may be difficult or impossible to do, if the lenses are not kept moist and the temperature thus held down.

The lenses are now to be ground on the reverse side. The first step after removal from the old block is gaging for thickness, this dimension being now of very great importance, largely because one side is already finished. The grinding and the polishing are processes similar to what they were before. Inspection is, naturally, an important matter. If a lens is of first grade then it must show no defect within an ellipse 1.56 x 1.20 inches set within the lens size 1.76 x 1.36 inches.

It has already been noted that a residue of 20 per cent acceptable glass from a melt of lead optical glass is satisfactory to the manufacturer. But the percentage is often much less. Sometimes it is as low as 10 per cent or less. Here we have a reason for a higher price for lead optical glass than for commoner varieties of glass. All this is accentuated, when it is necessary to find glass for the objectives for great refractive telescopes. It is only rarely that a single block can be found which weighs as much as 100 pounds, if perfection in quality is desired. "A single fine vein, perhaps too small to be visible to the unaided eye, may be found to run through a whole block in such a way that it cannot be removed without breaking or cutting up the whole piece, and it will be seen that the frequency with which this is liable to occur increases with the volume of the piece required."

Lighthouse lenses are made from glass which is manufactured by a somewhat different process. Instead of letting the mass of molten glass cool down in bulk and break up into fragments, it is poured into iron molds which give it approximately the final form desired. It is then ground and polished to exact size and figure. Rings for annular lenses are produced up to 48 inches in diameter. Segmental rings are made of still larger diameter—up to 7 feet. Most lighthouse lenses are of lime glass, but for special purposes a dense flint glass is made with a higher refractive index.

## Learning by Seeing

(*Continued from page 107*)

of the cutlery works at Sheffield, England. Subsequently he has extended this original and initial idea until at present the index of motion picture subjects offered by the Holley organization includes practically every mechanical, medical, industrial, commercial and scientific activity adapted to portrayal by pictures. Recently Dr. Holley has made arrangements with the National Department of Agriculture so that, henceforward, he will distribute the interesting films of this government agency not only throughout America but to every nation under the sun which wishes to learn about more progressive systems of farming.

Matters of personal hygiene, first-aid systems of treating wounds, the care and nutrition of infants, methods of sanitation as well as the rudiments of the three R's are now taught by pictures, the six million odd mountaineers of the Appalachian Mountain belt being the beneficiaries. The films and motion picture equipment are carried into the mountains on mules, the creek bottoms and trails being impassable for other methods of transportation and railroads in those regions being few and far between.

Despite the fact that the Bureau of Commercial Economics has over 35,000,000 feet of negaitve in daily use, last year it was able to supply only 45 per cent of the requests for film which it received. The Americanization of our foreign born laboring classes is a matter of critical concern at the present time and for educational work of this description the motion pictures speak the universal language. They appeal forcibly to both literate and illiterate and for the visualization of current ideas and patriotic events in American history, the motion picture is the perfection of pictorial appeal. The educational "movies" provide wonderful short cuts and top speed processes for the tutelage of the immigrant classes.

Motion picture trucks—unique among the "movie" theaters in the universe which travel from point to point in the rural districts of various foreign countries—carry the teachings of filmdom to millions of peoples each year. One of the trucks is on the Island of Sumatra off the Malay Peninsula where tens of thousands of natives work on the rubber plantations. Another outfit at Singapore furnishes highly prized amusement to the local laborers. The natives of the Island of Java sit about on mats, chewing betel nuts as they watch the marvelous picture shows which the "movie" truck provides for their entertainment. Other similar outfits are operated on the Island of Ceylon and in the Levant. The Bureau also maintains a film service which displays pictures on many of the river steamers in Russia in coöperation with the Siberian Steamship Company. In addition the Bureau has over 600 established centers in Latin-America, the chief difficulty being to supply sufficient negative to satisfy the continuous demands from Argentina, Bolivia, Chili, Mexico, Brazil and Nicaragua.

## The Heavens in August, 1920

(*Continued from page 109*)

use of mariners. The predictions made in this way are very good, except when exceptional weather conditions—such as a gale blowing the waters of a long bay or estuary toward one end—introduce unpredictable complications. It is probable, however, that only a small proportion of the mariners who make use of these predictions have any idea how they are made.

### The Heavens

The principal constellations are so clearly shown on our map that no long discussion is necessary. Cygnus and Lyra are right overhead, at the hours tabulated below the map for the different dates. Aquila, Sagittarius and Scorpio lie to the south and southwest, along the brightest part of the Milky Way. Ophiuchus, Hercules and Bootes are in the west and southwest, Draco and Ursa Major in the northwest. Cassiopeia and Cepheus are in the northeast, with Perseus rising below. Pegasus and Andromeda are high in the east, Aquarius and Capricornus in the southeast, and Fomalhaut below them.

### The Planets

Mercury is a morning star and is best to be seen about the middle of the month, when he rises at 3:45 A. M. (standard time).

Venus is an evening star, setting from half to three-quarters of an hour after sunset, and hard to see.

Mars is in Libra, and comes into quadrature with the sun on the 3rd, after which he may be considered an evening star, though he remains in sight until between 10 and 11 P. M.

Jupiter is an evening star at the beginning of the month, though too near the sun to be easily seen, but passes through conjunction on the 22nd, to reappear as a morning star next month. Thus we have the final breaking up of that brilliant combination of the three planets Mars, Jupiter and Saturn which has given the evening skies in this part of the world such unaccustomed brilliancy during the spring and early summer.

Saturn too is an evening star, setting an hour later than the sun in the middle of the month.

Uranus is in opposition on the 27th. He is then in Aquarius, in 22h. 23m. 34s. R. A., and 10° 54′ south declination, and is moving 9s. west and 52″ south per day. There are no convenient stars nearby to serve as guides, and he can best be identified with the aid of a good star map.

Neptune is in conjunction with the sun on the 3rd, and is invisible this month.

The moon is in the last quarter at 8 A. M. on the 7th, new at 11 P. M. on the 13th, in her first quarter at 6 A. M. on the 21st, and full at 8 A. M. on the 29th. She is in apogee on the 24th, and in perigee on the 12th—near new moon, so that high and low tides may be anticipated.

During the month she passes near Uranus on the 2nd, Mercury on the 12th, Neptune on the 13th, Jupiter and Venus on the 14th, Saturn on the 15th, Mars on the 20th, and Uranus again on the 29th.

On the afternoon of the 8th, Venus and Jupiter are in conjunction and only 40′ apart. This would be a handsome conjunction if the planets were not so near the sun that they will be very hard to see.

Clark's Island, Plymouth, Mass.
July 17th, 1920.

## The America's Cup Races

(*Continued from page 108*)

footed faster. Every yachtsman knows what that means. The "Resolute," beautifully sailed by Charles Francis Adams, turned the outer mark with a lead of 2 minutes 4 seconds, and down the wind "Shamrock" beat her by exactly that amount.

That two yachts of such radically different design should sail for a distance (actual) of 37 miles at an average speed of 9 knots and finish in a dead heat, is unique, surely, in the annals of yachting.

The "Resolute" won, therefore, by exactly her time allowance of 7 minutes 1 second.

If the cup is to remain in the custody of the New York Yacht Club, "Resolute" must now win two races, straight.

## Australian "Blackboy" Tree

A PECULIAR product of the vegetable world is what is known as the "blackboy" tree which flourishes in the state of western Australia. It is, in fact, a species of the grass tree, and grows to a normal height of 7 to 10 feet, and is found to be useful for a variety of purposes.

Until recently no attempt has been made to utilize the tree commercially, but a company has now been formed to work and market its by-products. The plant consists of 19 sets of retorts and furnaces, condensers, receiving tanks, etc., and can deal with 100 tons of gum and other material derived from the tree. The company at present employs about 20 men, besides cutters, and among other things being produced are tars (free from harmful acids), tarpaulin dressings, rope tar, and sanitary tar, lacquers (such as Japan black), steam and refrigerating pipe lagging, paint for ironwork that requires stoving at high temperature, stains and paints, pitches for marine insulating, phenol, benzol, and alcohols, coke, potash, and pyrogeneous acid. The production of dyes, perfumes, and formalin, and various kinds of varnishes is also planned.

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IN THIS ISSUE:

THE ROMANCE OF TUNGSTEN
WHO INVENTED IT FIRST?

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

LANDING AND SCALING LOGS NEAR THE LARGE MAINE FORESTS.—[See page 122]

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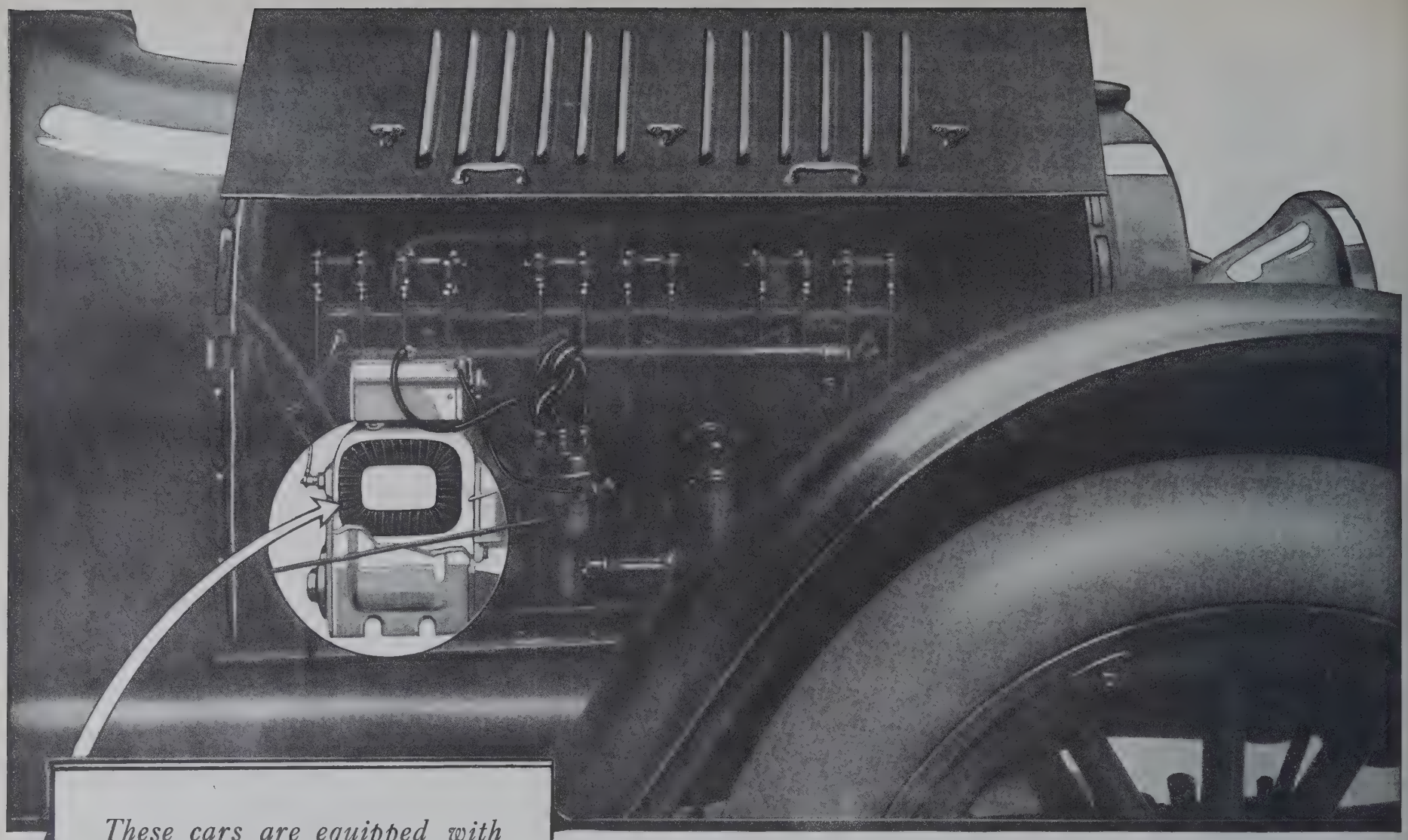

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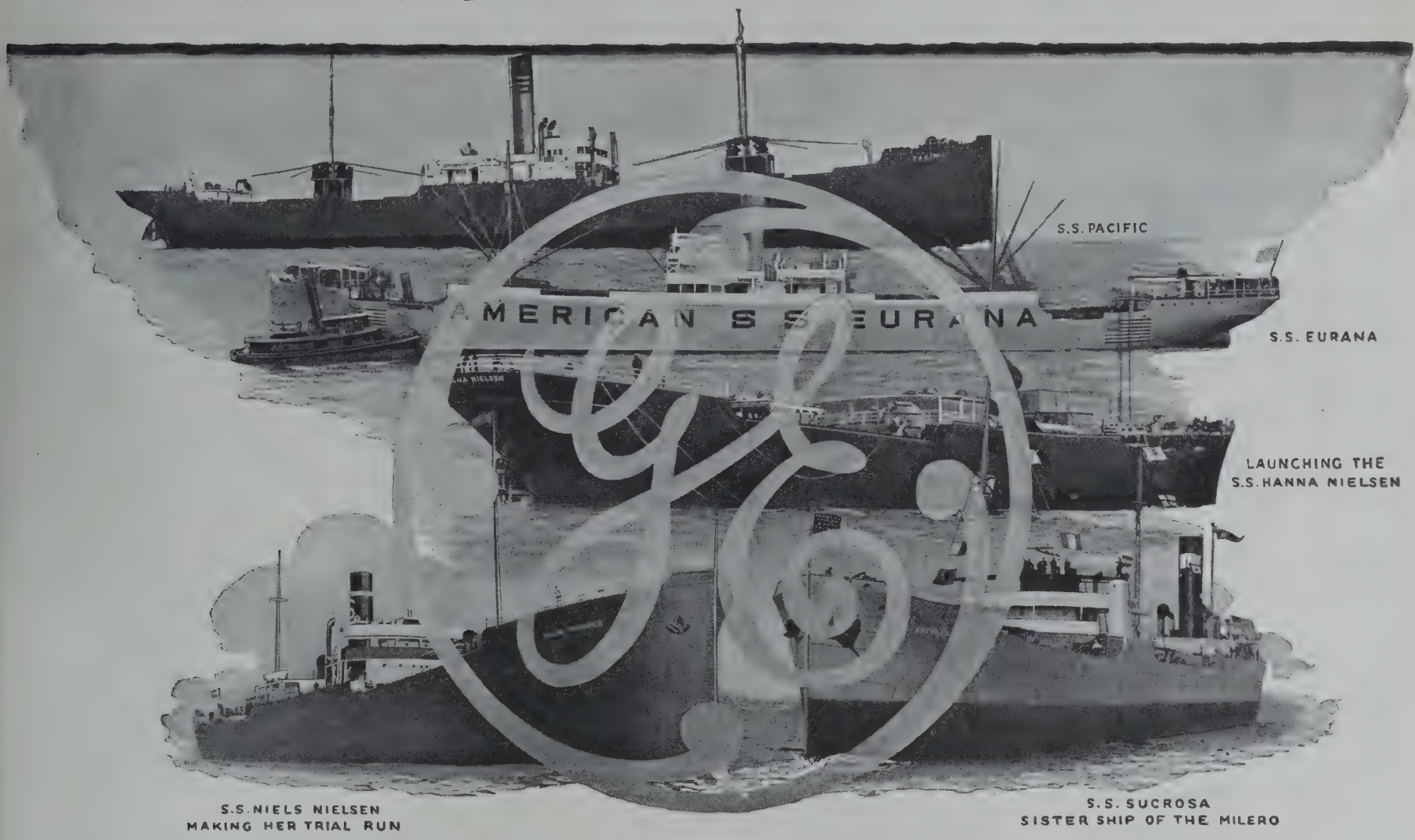


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# How Little Dollars Save Big Ones

MANY a truck owner has adopted his most profitable transportation ideas from the practice of the great railroads.

On *maintenance*, for example. The railroad sends its rolling stock into the shops every so many miles. Not because something *is* the matter. But so something *won't be*.

That is how a railroad keeps its rolling stock in prime condition—and the little dollar today saves the big dollar next year.

* * *

"I know that all machinery wears," says the truck purchaser; "but not so much with regular care. What sort of maintenance organization will you place behind my truck?"

Packard has definitely organized its Service facilities to keep maintenance expense of Packard trucks at the very lowest point.

None but the better mechanics of every trade are employed at Packard Service Stations. They are given machinery that augments their skill and facilitates their work.

Of first importance is *expert judgment*. What can a mechanic at half the price save an owner if he takes twice as long to find the trouble?

TODAY Packard service stations everywhere have in operation Uniform Service Methods — Uniform Stock-keeping Methods — a definite system to eliminate haphazard, time-consuming practice in repair shops.

More than one hundred repair operations have been standardized —workmanship improved and time reduced.

This system is solely Packard. There is nothing similar.

A maximum cost estimate of repairs and replacements is presented to the customer for approval before the work is started.

Packard Service is designed to apply the *ounce of prevention*. Packard understands perfectly that economy of maintenance of its trucks in daily use is the greatest factor in creating sales for new Packard Trucks.

Many Packard owners attend to truck maintenance on a set schedule. *A given day in each month for the truck to spend at the service station.*

These owners reduce maintenance cost—get the fullest advantage of Packard's 44 factors of engineering superiority—receive to the utmost the benefit of the long life built into every Packard Truck.

*"Ask the Man Who Owns One"*

PACKARD MOTOR CAR COMPANY, *Detroit*

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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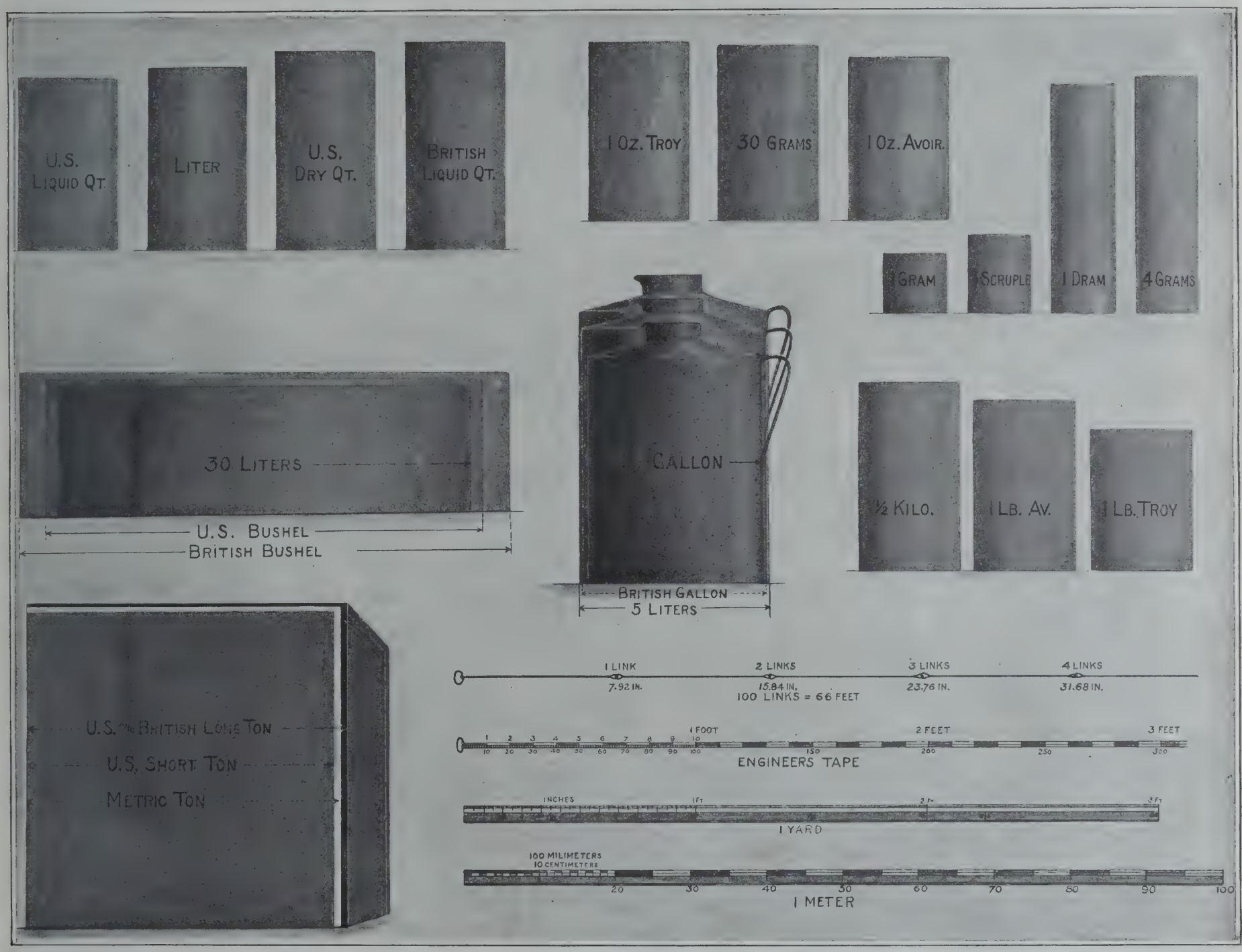


## Legal equivalents and ratios of the units and measures which appear in the above diagram

MEASURES OF CAPACITY

| | | | | |
|---|---|---|---|---|
| U. S. liquid quart | 57.75 | cubic inches or | 946.33 | milliliters |
| Liter | 61.025 | " | 1,000. | " |
| U. S. dry quart | 67.201 | " | 1,101.198 | " |
| Imperial quart | 69.366 | " | 1,136. | " |
| U. S. bushel | 2,150.42 | " | 35,238.3 | " |
| Imperial bushel | 2,219.7 | " | 36,367.7 | " |
| U. S. gallon | 231. | " | 3,785.332 | " |
| Imperial gallon | 277.463 | " | 4,545.963 | " |

A milliliter for all but the most precise work is identical with one cubic centimeter (1.000027 cc.).

MEASURES OF LENGTH

| | Inches or | Feet or | Centimeters or | Meters |
|---|---|---|---|---|
| Link | 7.92 | .66 | 20.117 | .2012 |
| Chain | 792. | 66. | 2,011.684 | 20.117 |
| Foot | 12. | 1. | 30.48 | .305 |
| Yard | 36. | 3. | 91.44 | .914 |
| Meter | 39.37 | 3.281 | 100. | 1. |

MEASURES OF WEIGHT

| | | | | |
|---|---|---|---|---|
| Ounce avoirdupois | 437.5 | grains or | 28.35 | grams |
| Ounce Troy | 480. | " | 31.103 | " |
| Gram | 15.432 | " | 1. | " |
| Scruple | 20. | " | 1.296 | " |
| Dram | 60. | " | 3.888 | " |
| Kilogram | 15,432.356 | " | 1,000. | " |
| Pound avoirdupois | 7,000. | " | 453.592 | " |
| Pound Troy | 5,760. | " | 373.242 | " |
| Long ton | 2,240. | pounds | 1,016.047 | kilograms |
| Metric ton | 2,204.62 | " | 1,000. | " |
| Short ton | 2,000. | " | 907.185 | " |

**COMMON WEIGHTS AND MEASURES USED IN AMERICA AND THE BRITISH EMPIRE, BASED ON THE SAME SERVICES AND HAVING THE SAME NAMES**—(See page 125)

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Fair Weather Yachts

ALTHOUGH the failure of "Resolute" and "Shamrock" to race in a 22-knot breeze and a tumbling sea on Saturday, July 24th, was a keen disappointment to yachtsmen who were rejoicing in the prospect of a battle royal to windward between the Cup yachts, the incident cannot fail to have a beneficial effect upon the future of such international contests; for it has served to emphasize once more the fact that scantling has been reduced and sail area increased to such a degree that the boats built to compete for the Cup are no longer seaworthy.

The conditions on Saturday were such as to justify the skippers of the two yachts and the Race Committee in calling off the contest. The wind, by the time the boats reached the starting line, was about 22 knots with a possible 28 knots in the puffs; but it was the steep and confused sea that constituted the danger. In broad reaching from Sandy Hook to the Lightship, both boats labored heavily, and the moment they came up in the wind, it was seen that the seas were so short that in a thrash to the outer mark, these fast moving boats would be heavily punished. Furthermore, they have no bulwarks and have nothing more than small, longitudinal cleats on which the crew can find a footing. The seas would have swept the boats fore and aft, and even if hull framing had held and masts had not gone by the board, it is more than likely that in a fifteen-mile thrash to windward, men would have been swept from the decks.

And yet the day was one that would have rejoiced the hearts of the men who sailed the sloops and cutters of thirty to forty years ago on this same historic Sandy Hook course. There comes to mind the classic race between "Puritan" and "Genesta," when the wind blew twenty knots at the start, and "Puritan" sent down her topmast and "Genesta" substituted a jib-headed topsail for her club topsail in the fifteen-mile beat back to the finish. Says the chronicler of that time, Mr. Winfield Thompson, "The wind was now squally . . . both yachts were sailing with their lee rails under water, their decks awash, the wind blowing at the rate of nearly thirty knots an hour, which caused an ugly sea."

The moral of this incident is that America should join all the other countries of the world in the adoption of the rule which is producing fast and seaworthy yachts that are serviceable alike both for racing and cruising. Unless a rule specifies a limit of lightness beyond which the designer must not go in any given class, clever designers, such as Herreshoff and Nicholson, will always find a way to build extremely fast and over-light boats, and yet keep within the rule. Under such a rule that staunch and very beautiful yacht, the 23-meter "Shamrock" was built. This craft has full cruising accommodations, is extremely staunch in construction, and has a turn of speed sufficient to satisfy the most exacting demands of the racing enthusiasts. She would have revelled in the weather conditions of Saturday. Our own rule produces a wholesome boat as regards form and sailspread, but it fails to set a limit upon light construction, and the result was seen on Saturday when "Resolute," in common with "Shamrock," was unwilling to face the music. It is for us, in common with the yachting nations of all the world, to set a ban upon freak construction, and build to a universally adopted rule which will enable our yachts to compete with yachts anywhere in the world, under similar conditions, at whatever port she may call.

## Wood as a Structural Material

SHORTLY before the war one of our leading bridge engineers made the statement that, in view of the enormous consumption of steel and the multiplying rate at which it was proceeding, the time would come when we should be threatened with a shortage of this material. Among the comparatively modern constructions which have made a heavy inroad upon our supplies of iron ore, he mentioned the towering office, hotel and apartment buildings, which, before the war, were being built by the thousand throughout the country. The enormous expansion in our industries has created a proportionate demand for tructural steel; and although the growing use of concrete has served to lessen the demand, the steel reenforcement foots up a heavy annual total. Although the building trades are passing through a period of stagnation, the reduced consumption of steel, due to this, is temporary and it will be more than counterbalanced by the tremendous demand that will ensue when normal conditions return, and we attempt to make good the arrears of construction.

As for the railroads, the largest part of the billions of dollars which will be required as a consequence of the neglect of the past half dozen years will be spent upon steel in the shape of rails and steel rolling stock. Moreover the great revival in our merchant marine, which we all hope will prove to be permanent, will call for heavy deliveries of shapes and ship plates—a demand which before the war was insignificant.

All of which suggests the wisdom of casting our eyes about in search of substitutes for steel, which can compete with it in cost and durability; and the first material that comes to mind is the wood of which we still have such a potential store in our sadly depleted but still magnificent forests.

Leaving out of consideration the extensive use of wood for home building, we are apt to forget how greatly we were indebted, in the earlier decades of our industrial progress, to our timber supplies for the construction of our factories, the marvelous post-war extension of our railroad system, and the construction of the famous clipper ships of our merchant marine. As regards the construction of our transcontinental railroads with their many ramifications, it is no exaggeration to say that, had it not been for the superb Douglas fir of the West and the long-leaf yellow pine of the South, the pioneer railroads of the last century could never have been pushed out over the continent at the amazing speed and for the very low cost which characterized their construction.

The Howe Truss timber bridge and timber viaduct—without these our pioneer railroad builders would have been helpless. For in those days, steel mills were few and steel was costly; whereas, once the Mississippi Valley was crossed the engineer found himself within easy reach if not in the very midst of vast forests of the finest structural timber in the world. All that was necessary for the crossing of rivers and the spanning of deep ravines was to erect a sawmill in the adjoining or nearby forest, and send east a bill of steel, consisting of screwbolts for his timber trestles and round bars for the tension members of his Howe Truss bridges, together with some simple castings for the footing of the compression members.

But all that was long, long ago; whereas our object is to suggest that there are many forms of construction in which we might turn once more to wood and get excellent results. Nor should the deplorable outcome of our recent attempt to build a fleet of wooden ships be allowed to shut the door upon wooden shipbuilding. Timber that was standing in the forest one month was framed into a ship the next—and ships that were built of green wood had only one fate in store for them.

But it is far from proved that there is no place for the wooden ship on the high seas. Yacht Designer Nicholson, who has produced a staunch and tight boat in "Shamrock," believes that the multi-ply system can be used on ocean-going ships, and that by sawing the timber into planks for "ply" construction, the wood can be so rapidly seasoned as to make it possible to reduce the time between the felling of the timber and its incorporation in the hull to a practicable limit.

As to the durability of timber, there are county wooden bridges doing good service, even today, that must have seen a good "three score years and ten" of service in the open, and there are timber roofs above the vaulted masonry roofs of European cathedrals that have stood untouched and perfectly sound for centuries.

## Re-Stocking Our National Resources

OUR national life these days seems to be little more than one worry after another. One day we hear that gasoline will soon be unknown; the next day we read that farmers are raising insufficient food and that we face an early famine; another day it is a coal shortage that stares us in the face; comes another day and it is our disappearing forests. Calamity threatens on all sides, to be sure.

These conditions are not something of the moment. We are always too ready to blame the recent war for our latest worries; and the shortage in production and our depleted resources are almost invariably charged up to our late military efforts. Yet the truth of the entire matter is that the world has long been living in the present, with little or no thought for the future. Thus forests have been cut down without consideration of the morrow; new ways and means of consuming petroleum products have developed without end; warehouses have been drained of their accumulated foodstuffs; coal reserves have been taken while waiting for improved transportation conditions. It is this matter of hand-to-mouth living that is to blame for our present predicament; and in this particular we are perhaps the worst offenders to be found anywhere.

The time has come for an accounting—for a national inventory so to speak. The various Bureaus of the Government, the leading industrial associations, and the large manufacturing organizations have taken a share in this inventory. For the first time these parties are seriously and exhaustively going through the cupboards of the nation in order to determine just what stocks we still can count upon in the form of natural resources. And the facts and figures of this nation-wide inventory are being passed on to the man in the street since he, as the ultimate consumer, must know why things are not as plentiful and inexpensive as they used to be. Furthermore, said man in the street must be taught to moderate his appetite for those things which he formerly considered inexhaustible.

For example: Our most pressing conservation question relates to our forests. Out of 850 million acres of virgin timber we have but 150 million left. We have effectually exhausted the timber lands of the Northeast and of the once magnificent forest States of Pennsylvania, Wisconsin and Minnesota. About ten years will see the Southeast, which has been our greatest producer of saw timber for years, out of the running as a serious competitor in the lumber markets. Already much of the timber for the thickly populated East and Middle West comes from beyond the Rockies.

Facts such as these are interesting, vitally interesting. They should receive wide circulation among thinking men. Such knowledge leads to a better understanding of present industrial conditions, and in a great measure must hasten and perfect the various phases of our gigantic re-stocking scheme which alone can ward off the several calamities with which we are threatened. The SCIENTIFIC AMERICAN has always made it a point to study all questions having to do with the welfare of these United States. Its editors have long foreseen the advent of this day when a nation-wide inventory would confront the people with cold, harsh facts about depleted resources and the urgent need of immediate conservation and replenishment.

Elsewhere in this issue there is a story of what takes place in the wake of the woodsman. It is a depressing story. It tells of the man-made deserts to be found in this country, where formerly there flourished the finest forests to be found anywhere. It tells of man-made floods which must now be combated with elaborate and costly dams. But it is a story that must be told if we are to avoid the mistakes of yesterday and to re-stock the nation's shelves.

## Electricity

**To Make Wood Acid Proof.**—Some storage batteries are carried in wooden battery boxes on cars and annoy the owners by leaking or slopping of the acid. To make the wood acid proof take six parts of wood tar and 12 parts resin, and melt them together in an iron kettle, after which stir in eight parts of finely powdered brick dust. The surface to be covered must be thoroughly cleaned and dried before painting with the warm preparation.

**Non-Leaking Storage Battery.**—A new storage battery said to be absolutely non-leaking has been produced. It has a special valve to let off the explosive gas, so arranged that no acid can get out. The plates are separated by strips of wood which not only prevent short-circuiting inside the cell, but retain the acid when the storage battery is upside down, giving an electrical efficiency of 75 per cent in this position. This battery is a German invention.

**Cable Construction.**—Despite the great development of wireless telegraphy, submarine cables are still being constructed, and with the great increase in commercial and journalistic messages are still regarded as a necessary alternative to wireless, and by no means obsolete or likely to fall into disuse. In fact, a new cable to the Far East from Great Britain through the Mediterranean, involving a length of 7,000 miles, is being laid section by section as ready, while the possibility of a new cable from Vancouver to Fanning Island is now being discussed.

**Electric Signals for Guiding Ships.**—In a recent French periodical there appears a description of a French method for guiding ships in foggy weather through narrow channels, harbors and so on. The method consists essentially in feeding with alternating current submarine cables or cables laid in the air along the piers and in observing on board ship the positions of said cables by the aid of frames connected to telephones. The frame can be rotated around an axis parallel to the fore-and-aft line of the ship, so that it can be ascertained if the cable is "starboard" or "port" of the ship.

**Hydro-Electric Development in Ceylon.**—It is reported that Ceylon has again taken up the work of investigating its widespread hydroelectric resources, which work was delayed by the war, and it is expected arrangements will proceed rapidly for the early initiation of the proposed electrification of the island's industries and the partial transformation of the transportation systems from steam to electricity, including the extension and development of the use of electricity for domestic purposes in Colombo and other centers of population. Although the standard American frequency of 60 cycles has been prevalently employed in eastern countries during recent years, the electrical adviser to the Government of India, who was lent to the Government of Ceylon to study the above projects, strongly recommends the British standard of 50 cycles, and states in his report that it is confidently anticipated that the consulting engineers employed to draw up the specifications will be able to place the order for the equipment within the British Empire.

**Suspension Insulators.**—Notwithstanding the recent improvements in porcelain insulators, failures are sufficiently common so that allowance must be made for them. A certain factor of safety is required, in the shape of extra insulation, to provide for the electrical unreliability of the insulators themselves apart from conditions of abnormal operating stresses. There are a wide variety of operating conditions which affect the amount of over-insulation required, and after having found the minimum number of insulators per string required for any given operating condition, Mr. A. M. Klamber, in a paper read before the American Institute of Electrical Engineers, points out a method of determining the amount of extra insulation desirable from an insurance standpoint according to the law of probabilities. Equations are developed from which the probability of failure for any given case or the ratio between such probabilities for any pair of cases may be determined directly. A numerical example is also given which shows the development of the theory of minimum annual cost for combined mechanical and electrical failures.

## Science

**An Entomological Expedition from Cornell University,** led by Prof. J. Chester Bradley, is spending a year in the collection and study of insects over a very extensive itinerary in South America. Most of the countries on that continent will be visited.

**A Memorial to Sir William Osler.**—Funds are being raised in Great Britain and the United States to provide a memorial to the late Sir William Osler. This will probably take the form of an Osler Institute of General Pathology and Preventive Medicine. Dr. Harvey Cushing, of Peter Bent Brigham Hospital, Boston, Mass., has been requested by Lady Osler to prepare a biography of her late husband, and announces that he will be grateful to anyone who will send him either letters or copies of letters, or personal reminiscences, or advise him of others who might be able to supply such information.

**Army Mental Tests in Schools.**—The National Research Council announces that the mental tests which were used with striking success in the Army during the war are to be used on a large scale in American public schools. A program of group tests has been worked out which will make it possible to conduct wholesale surveys of schools annually, or even semi-annually, so that grade classification and individual educational treatment can be adjusted with desirable frequency. Prof. R. M. Yerkes is in charge of this undertaking, and the General Education Board is furnishing financial support.

**The Cathode-Ray Oscillograph**—In a note on its investigations of this instrument, the Bureau of Standards points out the unique value of the cathode-ray tube as a means of studying the excessively rapid alternations and fluctuations of the electric currents used in radiotelegraphy. The Bureau states that this form of oscillograph can now be designed and constructed with a considerable degree of certainty to suit a variety of different operating requirements. The device is a valuable aid in the standardization of wavemeters, and in the determination of wave forms produced by spark and other types of radio generators. Its most conspicuous usefulness is in the study of the characteristics and behavior of electron tubes, as detectors and generators of current for radio purposes. As an implement of research, permitting visual observation of phenomena previously unseen and furnishing data for new ideas and theories, the cathode-ray oscillograph performs a service that can be achieved by no other device. The Bureau will eventually publish a Scientific Paper on these tubes.

**Susceptibility to "Ivy" Poisoning.**—In the disgraceful chaos of popular plant nomenclature—which English-speaking botanists ought to set in order at the earliest possible moment—a certain species of the genus *Rhus*, neither related to nor resembling ivy, is known as "poison ivy." Having thus relieved our feelings, we proceed to say that a valuable paper on the subject of "Ivy and Sumac Poisoning" has recently appeared in the *Public Health Reports*, and will, presumably, be distributed in separate form by the Public Health Service, Washington, D. C., to a great many applicants for information on this important subject. The authors are Drs. E. A. Sweet and C. V. Grant. One feature of the paper that seems especially worth quoting here relates to the question of susceptibility. It is well known that many people regard themselves as immune to the poisonous effects of "ivy," boasting of their ability to pull it up with their bare hands, etc. It appears, however, that experiments with persons of this type show that when they are subjected to prolonged exposure, or to the application of the toxic principle of the plant itself, they react to some degree, and are therefore not immune. Though varying degrees of susceptibility to the poison exist, a person may be repeatedly exposed without noticeable symptoms, only to have his pride humbled on a subsequent exposure. Some persons not ordinarily susceptible to "ivy" react to poison sumac (*Rhus vernix L.*). Moreover, certain persons who claim to be insusceptible to the effects of the leaves admit that smoke from the burning plant, which contains a finely divided but heavy dosage of the toxin, causes symptoms. The plants are most poisonous in the spring and summer.

## Automobile

**Use Current Sparingly in Winter.**—Do not connect additional apparatus, such as electrical horns, cigar lighters, etc., to the system without taking the matter up with the factory. The surplus capacity of the system is large but there is a limit to the amount of current which the generator can produce. Use the same judgment and reason in the operation of the electric lights on a car as you do those in your home or garage. When a car is running it is not necessary to burn all the lights, the two heads and the tail are all that are required or that are of any service. When the car is standing at night, use the side and tail lights only.

**Trucks for Forest Service.**—The United States Forest Service has lately gone on record as in favor of the employment of motor trucks for the gruelling service in the national forests. Chief Henry S. Graves of the Forest Service does not feel that the time has yet come for the government to outfit with passenger cars the forest rangers and other officials in charge of the national forests but for heavy transportation work in the forests, particularly when the fire menace looms, he is unqualifiedly in favor of motor trucks. On this score he recently outlined his position as follows: "I believe it will be desirable in the long run to have motor trucks in the forests where the hazard of fire is large for transporting materials and men to fires and for similar work."

**A New Gasoline Street Car.**—The preliminary test of a new type street car devised by a well-known auto and tractor builder at the shops in Dearborn, Mich., was declared to be a complete success. The new type of car will leave ahead of the Wolverine Flyer, between Detroit and Chicago, and will race it for a time record over the tracks of the Michigan Central Railroad, and in order to be successful will have to make 70 miles per hour. The power unit which will move the car represents a new combination of functions. It is a motor, an air compressor, an electrical generator, and a heating and lighting plant all in one. All operations necessary for the control of the car are centered in the motor. All this is accomplished, it is said, with a 75 per cent reduction in weight, as compared with the power and control equipment of the ordinary electric car.

**Extremely Light Auto Body.**—Mention has been previously made in these columns of the influence of automobile engine design principles on the development of the aerial power plant and now we find that aerial designers are contributing to the refinement of automobile construction, especially as relates to body construction. Our contemporary, *Automotive Industries*, describes a special five-passenger Sedan body which is claimed to weigh only 120 pounds for a car of 112 inches wheelbase. These bodies are constructed on airplane fuselage principles and are of a three-ply veneer combination. The great strength and light weight of plywood permits it to act as a sheathing and at the same time contribute considerably to the strength of the structure. The veneers usually employed consist of two plies of birch with a ply of mahogany between. The thickness of the material used in the construction of the conventional auto body is one-eighth of an inch.

**Motor Transportation in Palestine.**—The camel is being superseded by the motor vehicle and soon cars and trucks will be numerous in the streets of Jerusalem and other ancient cities of Palestine as well as being employed for interurban transportation. The slow moving, but fairly reliable, camel is to be replaced by the faster and more reliable motor truck mechanism. The problem of transportation not only in Jerusalem but throughout Palestine is acute. The railroads are few in number and uncertain in their schedules. Most of the passenger service of these roads was suspended during the war except for the use of troops. These roads are now in such a condition as to make other means of transportation necessary. The English since their occupation have been building up the important ports of Palestine and are planning to operate a fleet of motor trucks to these places to accommodate the influx of tourists to the birthplace of Christianity and to accommodate commercial travelers. A service from Jerusalem to Damascus in Syria is also being planned.

# In the Wake of the Woodsman

## The Great American Formula for Converting Forests Into Deserts

By H. A. Mount

THIS country is suffering a rude awakening just now to the fact that our forests are fast disappearing. This is chiefly due to the fact that our daily newspapers have been hardest hit through the restriction of their paper supply and they have become very willing spreaders of a much-needed propaganda.

We all dislike the calamity howler. As long as our favorite daily paper comes out on time and in its usual proportions we are likely to pay little attention to the front-page announcement that the supply of pulp wood in the United States is three-fifths gone, and that we are now dependent on Canada for two-thirds of our paper. And what if our Department of Agriculture solemnly warns us that unless we stop wasting our forests they will be gone in another fifty years? Fifty years—plenty of time to find a remedy and what's our Department of Agriculture for, anyway?

But there are times when optimism amounts to bad judgment and the man who pretends optimism about our national forests is poking his head in the sand. We need not wait a half century to see the results of a wasteful use of our forests and the lack of governmental care.

China's example is notorious. Once her lands were just as fertile and her forests just as "inexhaustible" as our own. Today these same vast areas are deserts that support no life—animal or vegetable. The reason is that China cut off her forests with the same reckless abandon with which we are destroying ours.

But we need not go to China for a horrible example. We have within our own boundaries the beginnings of deserts that are the direct result of cutting off our forests and subsequently neglecting the land. In two former articles we have dealt with the effect on our industries of our diminishing forests. In this one we shall consider the result to the land. This constitutes a more potent threat to the nation's future than any possible harm to industry, because it affects the fertility of the soil, the flow of rivers, the winds, the very climate of the continent. We can already begin to see bad effects, but appeals to stop the destruction so far haye fallen on deaf ears.

There is hardly a spot in the United States where one needs to go farther than ten miles from home to find examples of the erosion of the soil that follows cutting of woods from hillsides. From these it is easy to imagine the widespread devastation that comes from cutting off the timber of large mountain areas and then allowing the remaining vegetation to be killed off by repeated fires. There are many such areas in this country. Some of them have been standing barren for thirty years or more and are already potential deserts. Most of them have simply been rendered worthless and have been abandoned.

In the Manti national forest of Utah there are two eroded areas of nearly 50,000 acres each. Parts of North Carolina that once were cultivated now are eroded and abandoned. All over the New England States are small areas abandoned because of erosion.

"Every drop of rain that falls on more or less exposed soil," says a bulletin of our Department of Agriculture, "has the power of removing soil particles, and with them the soluble salts essential to plant growth."

Trees and plants break the force of falling rain and form reservoirs which prevent the water from forming rivulets which might cut deep gullies in the soil. The leaves and stems of plants and trees drip water for some time after a shower. The roots form a path of entrance to the soil and give the earth a spongy quality.

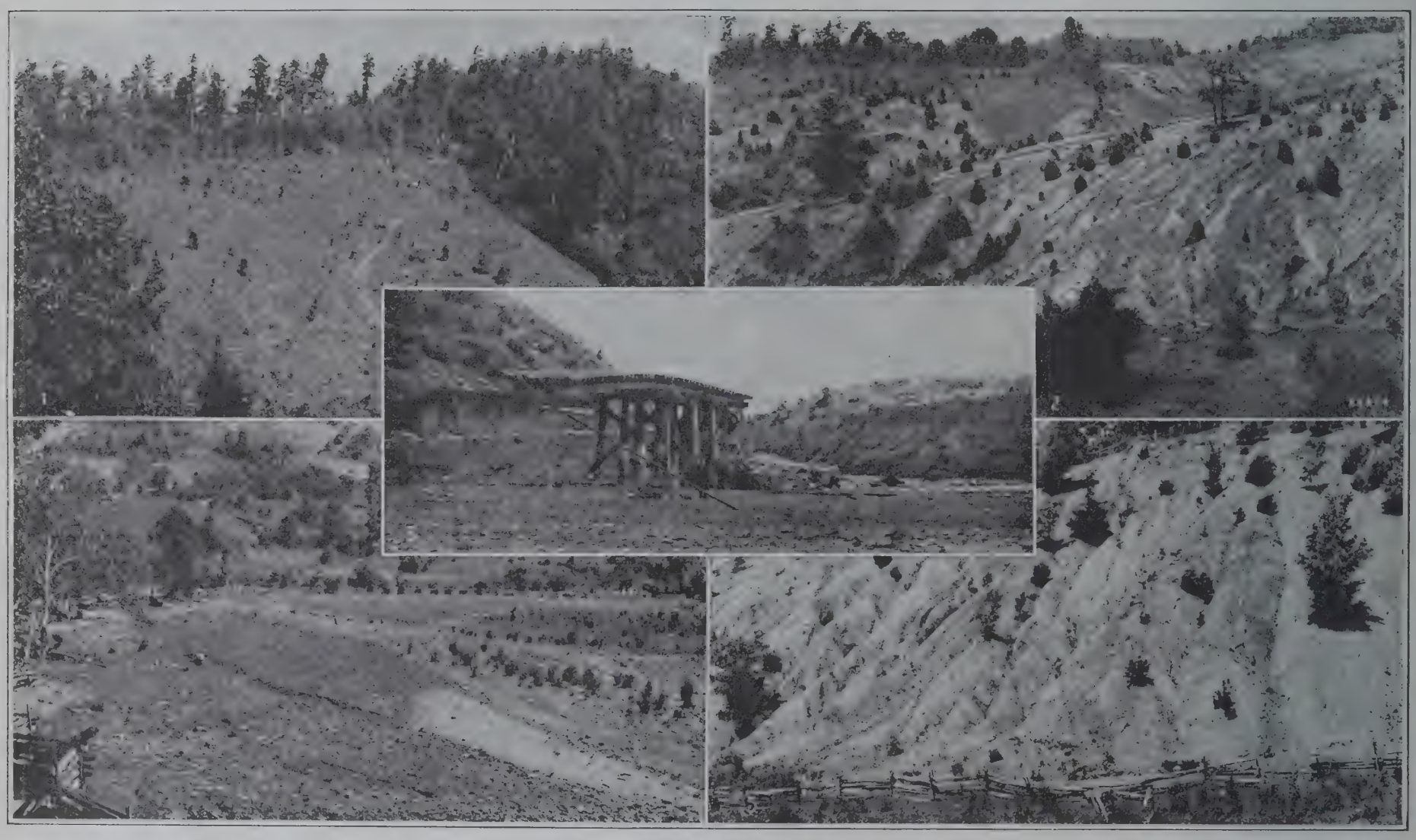
If the vegetation is gone the water quickly flows off, carrying with it part of the soil, and leaving behind stones and rock. As the waters combine and gather force their destructiveness increases. Creeks and rivers are overflowed and roads, power plants, property and even lives are destroyed.

China sees an extreme of this condition every year in the floods of her great Yellow River. Thousands of lives and countless millions of dollars' worth of property have been destroyed by this one river. In this country the Yellow River has a promising understudy in the Ohio. Nearly every year Pittsburgh and Cincinnati and many other towns and cities on its banks are flooded with disastrous results, principally because the forests of the West Virginia mountains, where the Ohio River has its headwaters, have been cut down.

The effects of erosion are not felt so keenly in the East as in the West, however. In some districts which depend on a natural watershed for a continuous supply of irrigation water, the flow has become erratic through erosion of the soil. Spring freshets send tumbling down into the irrigation ditches a great quantity of water, but in the summer when water is most needed the streams are almost dry. Many live-stock growers have made the discovery too late that cool forest shade and running streams in summer are almost indispensable to them.

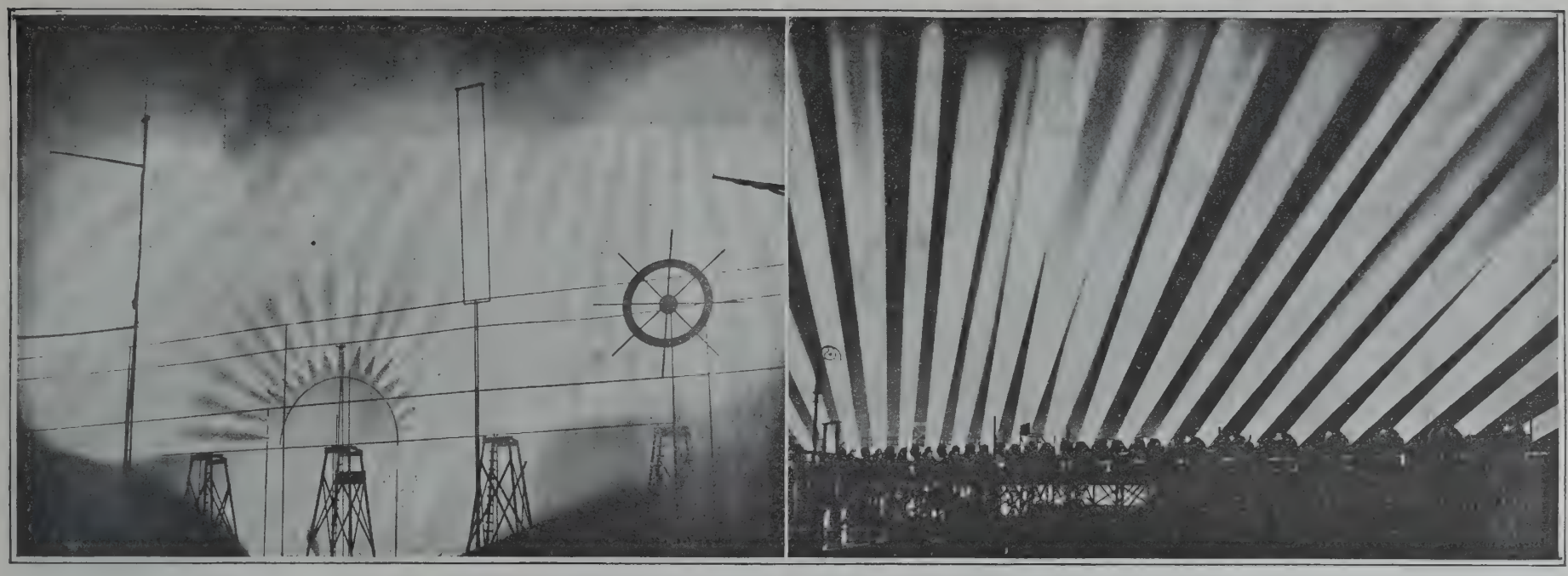
The worst feature of erosion is that the land is not simply denuded of its vegetation and gullied by rain, but the very fertility of the soil is destroyed. It will not support the plants which once grew on it

(*Continued on page 137*)



1. Very steep, rocky, washed land formerly cultivated in tobacco. North Carolina. 2. Deep gullies on abandoned hillside land on tributaries of Cane Creek, Mitchell County, North Carolina. White pine is slowly restocking this area, but the erosion is so rapid that seedlings with difficulty secure a permanent foothold. 3. Trout Creek, about five miles from Buena Vista, Colorado. Trestle of railroad left standing in midstream after washout in spring. 4. A seven-acre field badly washed by freshets. The top soil was eroded to a depth of from one to three feet in broad channels across the bottom. Where the soil has been eroded it is too rocky and sandy for cultivation. The land had just been plowed and planted in corn, and the lines of the furrows can be clearly seen in the unwashed place in the middle of the foreground. 5. Eroded slopes in North Carolina.

**Some examples—and there are hundreds of others—of what happens in regions where the woodsman's axe has been freely used**



*Left:* Some of the "fireless fireworks" effects produced by means of steam and incandescent searchlights *Right:* A battery of incandescent searchlights.

**Two striking examples of what may be done with the incandescent searchlight**

## The Last Word in Searchlights

**By E. W. Davidson**

IMAGINE attaching a searchlight to the lighting circuit in your house some night and throwing a beam so powerful that a man standing a mile away in this beam would have light enough to read a newspaper. It can be done. This is not to say it will be done often, however, for various protective devices would be necessary. But the incandescent searchlight which can operate on either an alternating- or direct-current circuit with proper auxiliary devices has established itself, replacing arcs of medium size for many purposes.

The first use of the new type of searchlight for spectacular effect was made at Saratoga Springs on the night of June 19 when that city turned on its new street lighting system in the midst of an illumination carnival. The powerful beams of 18 searchlights, playing through the heavens that night, were cast by incandescent lamps—a fact unknown to most of the thousands who witnessed the celebration.

These 18 beams wrought skilfully produced columns and curtains of steam into great, soft-tinted phosphorescent fans and plumes. They streaked the black sky with beauty, tracing bombs up into the night and dyeing little clouds of powder smoke with variegated tints. They turned the glare of ordinary fireworks into a radiant effulgence such as few Saratogans had ever seen. Their brilliant light helped make memorable the Saratoga festival of light.

But their use is by no means limited to gay, spectacular illumination. The incandescent is fast replacing the arc in searchlights of the type used by river steamers and coastwise vessels. Where a tower or high building facade is to be flood-lighted, the incandescent searchlight supplies accurately directed beams for the high points which are too dimly lighted by ordinary flood lamps. Where construction is proceeding at night and distances or heights are beyond the reach of smaller reflectors, these searchlights, ranging from a few hundred thousand up to ten or eleven million candle power, are playing their parts.

The new type of searchlight is the natural outgrowth of the lamp which succeeded, in the parlor stereopticon, the sputtering arc which did such doubtful service in the hands of amateurs. That stereopticon incandescent was such a marked improvement in steadiness, simplicity and economy over the arc that it was developed into proper sizes for small and medium moving picture projectors. The next step into the searchlight field was certainly a logical one.

Certain illuminating engineers who made the searchlight of both arc and incandescent types what it is today, labored long before they found the best method of shaping and mounting filaments so as to secure concentration of the light source in the incandescent lamp sufficient to produce a strong beam. Tungsten wire of various diameters wound into helical loops was tried in long coils and short—and even in a conical shape—but exhaustive tests showed that three types were superior to all others.

In a 115-volt, 1,000 or 1,500-watt lamp capable of producing from one to two million candle power in the beam, six perpendicular coils of filament are mounted in the formation of the letter C, the convex side of this arrangement being presented to the mirror.

The other two secure greater concentration for longer throws by operating at far lower voltages with corresponding higher currents. A 32-volt, 1,000-watt lamp good for about four million candle power has four perpendicular coils mounted at the corners of a close square. The third and most powerful of all is a 12-volt lamp of 100 amperes capable of developing as high as twelve million candle power in a beam of 3

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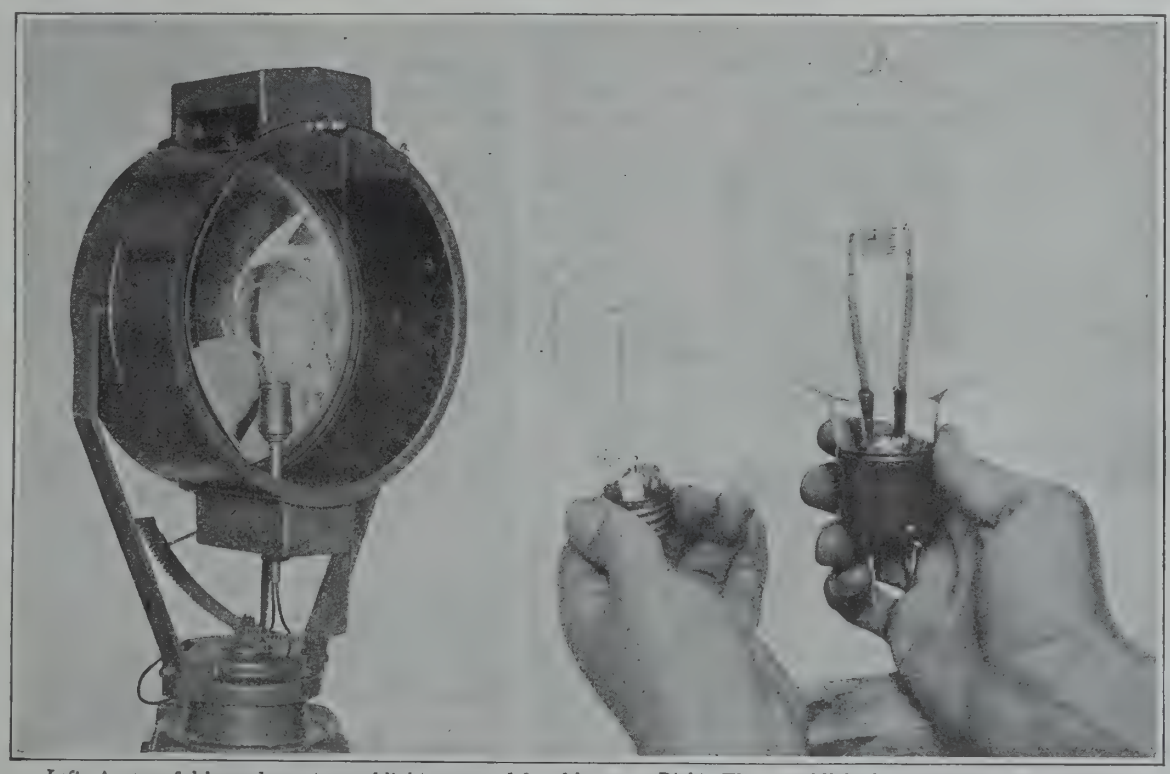

*Left:* A powerful incandescent searchlight mounted for ship use. *Right:* The searchlight incandescent lamp capable of producing 10,000,000 candlepower in the beam, and an ordinary 25-watt house lamp

**The incandescent searchlight and the lamp which made it possible**

## Guiding Ships by Electric Cables

**By M. Tevis**

DURING the war, while Germany held possession of Heligoland, the waters surrounding that famous island were, of course, densely sown with mines. Furthermore, in that vicinity dense fogs are very common, while, too, the mouths of the Elbe, the Weser and the Jahde are marked by violent currents and very high tides which make this part of the North Sea particularly difficult to navigate.

German ingenuity set itself to work to find some safe method of entering in and out of port during those hours when the fog covered them and protected them from the British lookouts. They did hit upon such a method and some time afterward it was discovered and utilized by the British, which enabled their navy to navigate without too much danger among the mine fields about Heligoland. A description of the process employed has lately been made public by Sir Arthur Evans, President of the British Association for the Advancement of Science.

To begin with, electric circulating cables carefully protected by metal coverings against fraying at the bottom were fastened to the ground at one end near a station possessing powerful alternators for sending alternating currents. All of the ships were provided with precision instruments which by induction were influenced by these currents in proportion as they approached the vicinity of the cable or, more exactly, when they came above the cable, at which moment the records of the registering apparatus grew fainter or slightly changed direction before reaching a maximum once more.

Some of these one-direction cables were as much as 90 kilometers long, and Sir Arthur Evans declared with enthusiasm that the captains of vessels became able to follow the cable at any speed whatever as easily as the street car follows its rails. It is obvious that this ingenious device is destined to give tremendous service in time of peace, as well as in time of war, especially in ports where the channels of approach are devious and difficult to follow and where there is much fog, both conditions being considerably prevalent along the English coast. From the moment a ship "picks up" the outer end of the cable, the man at the wheel need no longer be troubled by reefs, shallows and currents or even by fog.

Two cables have already

(*Continued on page 138*)

# Who Invented It First?

## Some of the Knotty Points That Come Before the Examiners in Interference

By John Boyle, Jr.

SOME one has said that there are three critical periods in a man's life: when he marries, when he starts to build his own home, and when he begins to raise chickens. To these might well have been added a fourth: when he begins to invent. There is no general appreciation of the number of people in this country who show a disposition to invent. The reports of government officials show that more than 70,000 applications for patents were filed in this country last year, representing substantially as many American inventors. There are over 600,000 unexpired patents which represent conservatively half a million living American inventors. It would not be an exaggeration to say that there are probably one million present, past, and prospective inventors alive in this country today.

With so many individuals interested in the subject of inventions it is not at all surprising that there should be times when their paths cross and conflicts arise as to the origin of some specific invention. Whenever the attention of the public is focused on some great undertaking, individuals in all parts of the world begin to devote their attention to the solution of the pressing problem. During the war when the submarine activity was at its height, the British Government received, in a few months, not far from 40,000 suggestions of ways and means to curb this menace; the number of suggestions received by our Navy Department far exceeded this. After the Iroquois Theater fire in Chicago some years ago, all kinds of protective schemes found their way into the Patent Office. The same thing happens after every big train wreck, or any other calamity the news of which is spread nationwide. A multitude of applications for patents were filed after the announcement of the sale of a concrete fence-post invention for a quarter of a million dollars; and also after the publication of the sale of the patent rights of the autographic kodak invention for a large sum. And it is entirely obvious that when a lot of people—scores or hundreds or thousands, as the case may be— get to work on the same problem, a lot of them are going to produce solutions which to all intents and purposes are identical.

Whenever two or more applicants come into the Patent Office claiming a patent for substantially the same invention, some method must obviously be devised in order to determine to whom the patent shall be granted. Only one valid patent can be granted for an invention, and under the law it must be granted to the original and first inventor thereof provided he has been diligent in reducing his invention to practice either by the construction of an actual working model or the filing of an allowable application. The question therefore to be determined is, which one meets these requirements. The proceeding which is instituted for this purpose is technically known as an interference proceeding. Every year nearly a thousand of these contests are instituted of which about one-third come to a final decision. There are two important facts in the development of an invention which it is necessary to understand in reaching a decision as to who is the prior inventor and hence entitled to the patent. One is known as conception of the invention and the other as reduction to practice of the invention.

Whenever a person begins to invent, the first step is in appreciating the desirability of doing something in order to fill a certain want. There then comes to the mind of the inventor some specific means for accomplishing the desired result. Ultimately he is able to make a sketch or a model or a working drawing thereof. When he has proceeded thus far he is said to have a complete conception of the invention. In other words, he has in his mind a definite scheme as to how he intends to construct his machine for accomplishing the desired purpose. He is not considered to have invented anything until he has reached this stage in the perfection of his ideas.

In order to perfect the inchoate right which the inventor has acquired through the conception of the invention he must now proceed to demonstrate the practicability of his device for the purpose for which it was intended. The fact that an inventor has made a drawing of his invention is not always conclusive that it will do all that it is intended to do. This can be demonstrated by subjecting it to an actual test under the conditions that would exist in practice; or as a substitute for this test, the inventor can perfect his inchoate right by filing an application for patent. This is designated in the law of patents as a constructive reduction of the invention to practice.

The pervading idea in the whole system of our patent laws is to benefit the public. As a reward for conferring this benefit on the public the law gives the inventor an exclusive right to make, use and sell his invention for a term of 17 years. This right will not be conferred if there is any doubt as to whether the invention will do all that is claimed for it. Hence the requirement as to reduction to practice.

Several different sets of conditions arise in these contests between rival claimants for a patent for the same invention. The most common is that between independent inventors; let us take such a case and see by what rules it would be decided. John Doe, a professor of physics at Harvard, wishing to contribute his little bit to winning the war, begins to devote his attention to finding a device that will detect and locate an enemy submarine. After much speculating and planning, in December, 1916, he has such a definite notion of an apparatus that will do this that he is able to make a drawing of it in complete detail. He takes this drawing around to one of his fellow professors and explains to him his whole scheme and is greatly encouraged by the favorable comment. Thereupon he begins to wonder how he is going to test out his device and demonstrate with certainty that it will do all that he expects it to do. While still considering this phase of the problem and before taking any definite steps to this end he hears that considerable trouble is being experienced by the allies in finding an effective gas mask. He thereupon lays aside his submarine detector and takes up the problem of inventing a successful gas mask, prosecutes the investigation with vigor, and by July, 1917, he has developed a gas mask that meets with the approval of the military experts. Stimulated by the success he has won in this field, he returns with renewed effort to his submarine detector. In September, 1917, he sends the drawings of this to his attorneys for an investigation of its patentability. The report is a favorable one and on October 1, 1917, he files an application for patent.

The scene now shifts. Comes Richard Roe, professor of physics in the University of California. Embued by the same spirit of patriotism as John Doe, he too begins to experiment with submarine detectors. He has reached such a point in his investigations by February 22, 1917, that he is able to make a drawing of his device, which he immediately sends to the Navy Department. Favorably impressed with the apparent utility of the detector, the Secretary of the Navy wires him to report at once to the Mare Island Navy Yard in order to have his detector tested. At a test carried on under the supervision of the yard officers he is able to detect the direction and distance of a submarine within a radius of twenty miles. On December 20, 1918, he files an application for patent.

Now the officials of the Patent Office had decided only a few days previously that John Doe was entitled to a patent for his submarine detector. But Richard Roe's detector is a Chinese copy of John Doe's. To whom shall the patent be granted? To Richard Roe, even though he was the last one to think of the device, the last one to make the drawing, and the last one to file an application for patent! But he has this all powerful fact in his favor: he was the first to reduce his invention to practical form, the first to go from the depths of probability to the field of certainty. His device will do all that is claimed for it because it has done it. If he were to die the day after the test he would have left behind him for the benefit of the public a definite and certain addition to the sum of human knowledge. His ideas would not have been clothed in speculation and uncertainty.

Now in all fairness it would seem that if John Doe was the first one to think of the submarine detector he ought to be prior in right to Richard Roe. And so the law does say and do, but with a snapper proviso on it. The reason that John Doe lost his right to a patent was because after he had conceived the invention he temporarily abandoned the idea to work on the gas mask. During the period that he had laid aside his invention, Richard Roe, unaware of the prior activities of John Doe, entered the field, conceived and reduced to practical form his own detector.

The hard lesson that John Doe has learned should be a warning to all inventors. If you are an inventor and have a definite conception of your invention, either hasten it to completion and actual test or file an application for it in the Patent Office. The first course is the preferable one, but if that is impossible then the second course should be followed. The law says that you must be diligent in reducing your invention to practical form otherwise you take the chance of some more diligent rival cutting the ground out from under you.

It may not be an inopportune time now to issue an additional warning to inventors. From a patent standpoint nothing is quite so fatal to an invention or discovery as secrecy. Of course if an inventor prefers to manufacture by a secret process and is certain that he can keep it secret, there is no objection to such a procedure. The inventor and manufacturer of a leading photographic paper has done this to his great financial benefit. But the situation under consideration here is where two or more inventors are seeking a patent for the same invention. The one will secure the patent who is able to prove the earliest acts of invention, that is to say, the date and character of his conception and also of his reduction to practice. Now if he has kept in his own heart all that he has done along this line he will have no evidence in the eyes of the law wherewith to prove that he has done what he claims to have done. It behooves every inventor, therefore, to keep some individuals—who are competent to understand and to testify to those facts if necessary—informed of all that he is doing in the line of inventing. Unless it is a very simple device it will not avail much to disclose it merely to your wife or your mother-in-law. Being interested parties, too, their testimony is not entitled to much weight.

The fear of having an invention stolen is something that seems to obsess many inventors and is probably the reason that impels them to secrecy. There were probably more Liberty bonds stolen on any day last week from reasonably secure places of deposit than of attempted steals of inventions in the whole history of the Patent Office. The inchoate right to a patent has been threatened oftener by the veil of secrecy than by the crime of thievery.

One of the most interesting and leading cases of the penalty of suppression and concealing an invention was decided in 1902. An inventor, Mason, conceived the idea of a certain kind of gun-clip, had it made and applied it to a completely finished gun. The invention was a simple device and complete in all its details. It was put away in the model room of the company which employed Mason and was entitled to the benefits of his inventions. No clips of this kind were put on the market and the gun and clip were never exhibited to the public. Seven years after the completion of the invention another inventor by the name of Hepburn, unaware of the activities of Mason, filed an application

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*THE troubles of the inventor in interesting capital and getting his invention developed are an old story. Perhaps a little less familiar are some of his troubles in getting his invention past the gentlemen in the Patent Office whose duty it is to discover whether the alleged features of novelty are really new or not. It is obvious enough that if we reinvent independently and unknowingly something that has already been invented and patented, we can't expect the Government to give us a patent on it in return for "disclosing" it. What is not quite so plain, however, is that even in the absence of a prior issued patent we may have nothing that is entitled to consideration as new. How the patent examiners decide between the claims of two men who come before them with substantially the same invention, and how these men can best protect themselves in advance against an adverse outcome in such a case, are the things that Mr. Boyle tells us in this article.*—THE EDITOR.

# The Metric System

## Why We Should Measure in Meters, Grams and Liters, without Reservations

By Herbert T. Wade

THE growing and active interest in the serious discussion of the necessity of adopting the metric system in the United States has been reflected recently in the correspondence columns of the SCIENTIFIC AMERICAN. This paper for many years has believed that the adoption of the metric system, logical in its development and international in its application, would accomplish as much for manufacturing and other industries, commerce and the ordinary transactions of life in the United States as it has done in continental Europe and also in purely scientific work where its use is now universal.

It is always difficult to convince the general public of the desirability or even necessity for changes in weights and measures, and it is the experience of history that such reforms as well as those of the currency and coinage always must originate with a few enlightened and far-seeing persons and be forced upon an indifferent or hostile public. Even in matters of such vital importance as fraudulent weights and measures, false statements of quantities and similar matters, there rarely is evident any general demand either for legislation or for the enforcement of statutes bearing on this subject, and what has been accomplished has been done through the interest of a few rather than in response to the demands of the many.

### Again the Apathetic Public

Accordingly, while the matter of weights and measures both ultimately and directly concerns the general public and it is widely realized that American and British weights and measures are dissimilar, illogical and inefficient, yet it must be admitted that today there is voiced in neither country any widespread and compelling demand for changes and improvement. But as always there are now scientific and public-spirited citizens advocating reforms which are as vigorously opposed by others. As a result the people of the United States have been treated to an almost endless discussion and argument by two hostile camps composed of enthusiasts, propagandists and controversialists, comparatively few in numbers, with whom the calm consideration of facts in the light of experience, the analysis of conditions and underlying theory, and the technical, economic and logical development of the question too often have been conspicuously absent.

With the great mass of the people indifferent to metrological reforms it is all the more the duty of thinking men and women to examine the arguments and conclusions developed by those who have given study to the matter, and most of all the underlying facts, record and experience. As a consequence they will be forced to espouse one of the three following propositions: First, that there are no reforms necessary in the American and British weights and measures; second, that the existing American and British systems of weights and measures, with their duodecimal and binary system of subdivision, can be simplified, harmonized and referred to common standards with more or less modification to a decimal basis; third, that the international metric system, now in universal use throughout the world for all scientific measurements and in commerce and industry in the majority of civilized countries should be employed universally and by statute in America and Britain.

### Why the Metric System?

For each of these points of view arguments can be and are advanced, but, in our opinion, experience and logic are overwhelmingly in favor of the adoption of the international metric system, and especially if it can be carried forward on a sane and progressive basis, with due regard to the interests of all.

And this in no way contemplates the impossible or impractical. No one proposes arbitrarily and immediately to change to a metric basis such standards as railway track gage, airbrake hose, couplings or other railway fittings. But it does mean that for new types of material and new types of construction not only metric but international and universal standards should be used.

Decimal coinage has demonstrated its supremacy throughout the world, and so far as calculation and reckoning are concerned, there is no more reason for the survival of the Anglo-Saxon weights and measures as a system than for the system of currency based on pounds, shillings and pence, which progressive thought in England desires to change. It requires only a recollection of school day arithmetic to recall complicated tables with many and unnecessary units used only by those directly concerned with a special trade or calling, and the inevitable question comes, Why is the capacity measure for a liquid different from that for a dry material, or why is a bushel different in different parts of the United States? Furthermore there is not today harmony in the weights and measures of the two great English-speaking countries either in systems or standards; tons, gallons, bushels and other units are absolutely different. Though the yard, foot and inch are the same in both, yet, as a matter of fact, they now are ultimately referred to the standard prototype meter for their precise definition.

### Argument Based on Conservatism

While some favor a binary or duodecimal system from a spirit of conservatism and for alleged facility in construction, especially in hand work with dividing or foot rule, yet in actual practice these points of superiority rarely appear, at least as important elements. Of course, on the Anglo-Saxon systems of the two great nations have been built many machines, and engineering and other information have been compiled either in an extensive literature, or in valuable tables, which with any change would be rendered obsolete or require transformation. However, so far as material things go, much here is obsolete or obsolescent, change or no change, and if what is to come in design or construction or a literature or tables can be devised on a new improved and universal system, inconvenience and incidental loss would be far less than feared.

A partial change would cause practically as much inconvenience and trouble as the adoption of a new system, and the only elements that would be maintained would be the linear units and standards, with perhaps the avoirdupois pound and even for them a new and decimal subdivision is proposed. With the difference between the American and British ton, the American and British gallon, the American and British bushel, there would be important adjustments necessary in at least one of the two countries that stand pre-eminent in the world's trade, while so far as linear measurements are concerned, and here the large machine tool and manufacturing industries are concerned, any modification or readjustment of the Anglo-Saxon measures would lead to almost as much confusion as an entirely new system.

### How to Save Clerical Work

Advocating the international metric system, therefore, it is not necessary to advance the familiar arguments, many of which are sound, but to suggest a point of view that we think has been to a large extent overlooked. In modern American manufacturing cost analysis and accounting has become as general as it is necessary, and this involves considerable clerical work and calculation. Even today the metric system could be introduced into much industrial work with small expense in the way of providing suitable weights, measures, scales and weighing machines, and in the control of processes the data at any stage would be secured and handled with much less effort and clerical labor. Just as a decimal hour is used in many establishments, beginning with the raw material it would be possible to employ metric weights and measures in every stage until the final product with a considerable saving and increased efficiency. In an establishment we have in mind, a practical industrial engineer informed in weighing and measuring methods, both scientific and practical, estimated that a saving in clerical labor representing between five and ten thousand dollars per annum would be secured by recording all weights and measures in the metric system, eliminating the inconvenient avoirdupois and troy systems, both of which were used in this special plant.

There are certain industries or certain departments of large industries, where such an experiment of introducing the metric system exclusively could be carried on for one or more years with every prospect of material advantage; and it is to be urged that this be done under enlightened and scientific direction by such corporations, and that the results be described to some convention of mechanical or industrial engineers. Such work on a partial scale is done in some mechanical and electrical manufacturing plants in the United States and in a few concerns working from European plans or European orders, without, so far as can be learned, the slightest embarrassment or difficulty, but it is urged that this method be tried as an efficiency measure and the experiment should be well worth the effort. Indeed to many engineers who have given thought to the matter the practical efficiency of the use of international metric weights and measures is a single argument sufficient to warrant its adoption.

### The Serious Matter of Screw Threads

In manufacturing the mere branding of a product with its metric equivalent is a simple step, which will prove at once advantageous to foreign trade and one that can be recommended as distinctly worthy of adoption. The crux of the situation in the United States as regards the adoption of the metric system confessedly lies in the enormous and efficient machine tool industry, where standards have been followed both of individual manufacturing concerns and those conforming in general to accepted practice and based on the Anglo-Saxon system of units. In these the matter of screw threads plays an important part, and an American system has been evolved, while abroad is found a British standard system, and also one based on the metric system in less common use, known as the International System. Commissions are now concerned with the study of the American and British screw-thread systems, and of international standards in general, and it would seem to be a proper time to take action to secure an international standard which in future construction could be used. It would be desirable to have such a system based on the metric system rather than on the American or British system exclusively, and it might be suggested as worthy of the attention of an International Engineering Commission or Congress to evolve satisfactory and efficient systems of screw threads that could be used in future construction for articles designed for international commerce, and particularly for new types of machines whose construction is about to commence. Mechanical engineers in all countries must realize that production must be carried on with a view to the markets of the world, and that international standards must prevail if any individual country hopes to secure its proper place in the world's markets. The time has passed when a single nation can impress itself and its products by force on any other nation and compel acceptance of ideas and articles, and international weights and measures are distinctly in line with the progress and enlightenment of the times.

## Mechanical Bond in Reinforced Concrete

MUCH ingenuity has been displayed by inventors in the production of patented bars and other forms of reinforcement for concrete, generally, but not invariably, with the object of providing a mechanical bond to supplement the grip or adhesion between the concrete and the steel, says a British writer. As remarked by Professor Turneaure, "America is the home of the patent bar," for European engineers generally agree that the natural adhesion bond between concrete and embedded steel bars is quite sufficient to comply with essential conditions. Nevertheless, it may be at once admitted that a supplementary bond is worth securing, if the form of the bar is one not likely to cause undue strain in the concrete and if the cost of patent bars is not too high.

Many forms of patent bar are made with swellings and other projections which tend to split or shear the concrete, if the bond stress exceeds the usual working limit, and all forms of such bars cost considerably more than plain bars. So far as concerns safety from excessive strain, a good form of patent bar is one giving a continuous mechanical bond furnished by a helical surface formed by twisting bars of square or special section either after or during the process of rolling. If the operation of twisting is performed with due care after rolling the yield point and ultimate strength of the metal are raised to an important extent, while at the same time the bars are not subject to the small amount of permanent set which occurs in plain bars after being loaded for the first time. Therefore, twisted bars may provide a higher factor of safety as well as a continuous mechanical bond. In the case of bars twisted during the process of rolling the physical properties of the steel remain unchanged, but this method of treatment should lead to the production of mechanical bond bars at minimum cost.

**The 12,000 ton (deadweight) "Invincible," built on the Isherwood longitudinal system**

# Our Deep-Sea Freighters

## Something of Permanent Advantage that We Got from Our Participation in the War

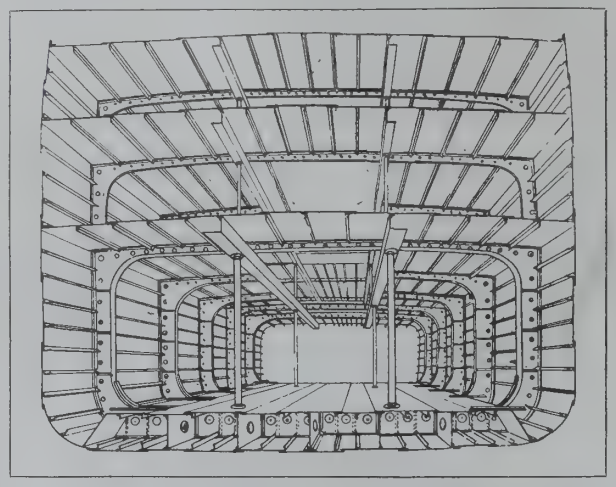
By Robert G. Skerrett

THE test of time is going to tell in our favor and bring out the fact that we fought in the World War to our lasting advantage, and this, in a sense, apart from the immediate consequences of our participation in that conflict. That is to say, the urge of strife spurred us on to achievement in one direction or another where we might otherwise have hesitated for years.

This is undoubtedly true in regard to our sudden and spectacular creation of a really formidable array of deep-sea shipping. Our newly revived merchant marine will be a worth-while aftermath of the recent struggle if we prove wise enough to make the most of these craft and to profit by what we learned in bringing them into being. It is true that mere expedition of construction cost us doubly dear in many instances, but, even so, the price was not exorbitant provided we put the sound knowledge gained to good account. That is to say, pick out the types of steamers that have since revealed their merits in service and then reproduce their kind as occasion requires—sedulously avoiding, of course, the duplication of ships that have not measured up to peacetime standards.

Among the array of vessels constructed in our various yards, the public at large has heard little about two 12,000-ton freighters built at Alameda. Not only were these boats turned out in a remarkably brief time, but they represent an order of hull get-up characterized by qualities calculated to command the attention of marine architects, shipowners and the operators of oversea cargo carriers. The steamers in question are the "Invincible" and "Courageous."

These craft were of a group of single-screw steel vessels actually in hand at the California yard for the Cunard Steamship Company when we joined forces against the Central Powers. Subsequently, the "Invincible" and the "Courageous" were requisitioned by the Emergency Fleet Corporation and completed and commissioned by that organization. The keel of the "Invincible" was laid on July 4, 1918, and the boat



**Cross section of Isherwood system, showing arrangement of deep frames and deck beams**

was put overboard on August 4, following, the actual working time being 23 days and 23 hours. She had her trial trip on October 11th, and was duly delivered to the Government authorities five days later. The keel of the "Courageous" was laid on July 4th; she was launched on the 22nd of September, and on the 27th of November she made her trial run and was likewise delivered to the representatives of the Emergency Fleet Corporation. Despite the fact that these freighters were constructed very rapidly they were nevertheless subjected to exacting inspection and were given the highest classification according to Lloyd's register of shipping. This climax was in part due to the method of construction adopted, which lends itself to both quick and thorough work.

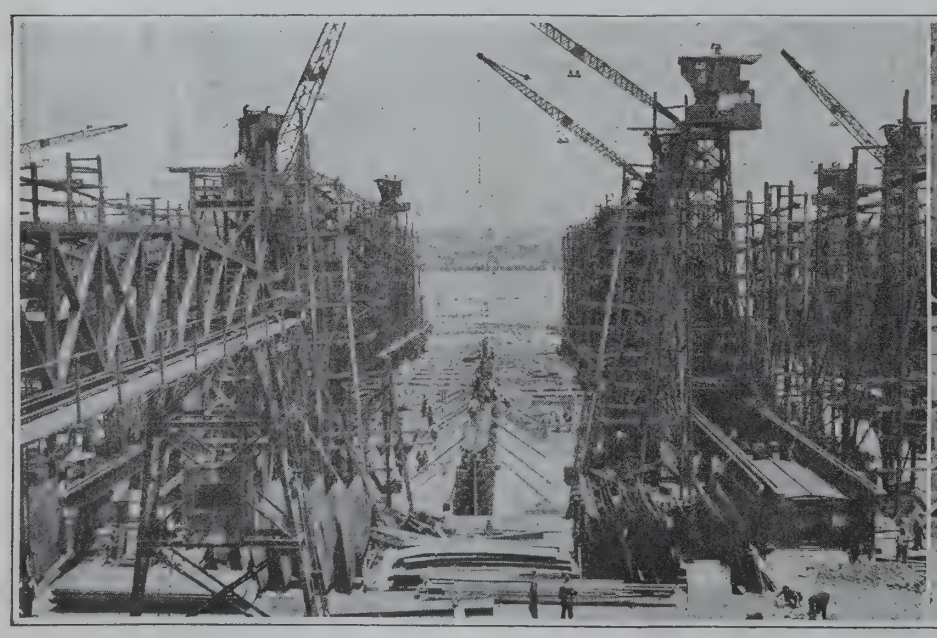
For the sake of those interested in figures, the following particulars of the two ships will probably be acceptable:

| | | |
|---|---|---|
| Length between perpendiculars | 440 feet | |
| Breadth molded | 56 feet | |
| Depth molded to upper deck | 25 feet | 6 inches |
| Depth molded to shelter deck | 38 feet | |
| Height of 'tween decks—top of beam to top of beam—at side and amidships | 9 feet | 6 inches |
| Deadweight tonnage | 12,000 | |
| Maximum mean draft | 27 feet | 7¾ inches |
| Block coefficient about | .797 | |

These vessels are built upon what is known as the Isherwood system of longitudinal framing, have straight stems and elliptical sterns, with a complete flush steel shelter deck. They also have a steel upper deck extending from bow to stern, and the living accommodations are located in three steel houses on the shelter deck.

Each ship handles its freight through five main hatches in addition to a hatch leading into the deep tank—the latter, which is abaft the engine room, is suitable for either cargo or water ballast. The double bottom which is built upon the cellular system has piping to five of the six transverse compartments which

(*Continued on page 139*)



**Laying the keelplate, July 5, 1918**

**The condition of the work July 9, 1918**

### A River Wall in Which Wire Mesh Replaces Mortar

A TREACHEROUS southern California mountain river, the San Gabriel, subject to tremendous floods, was held in check the past winter and spring by a wall constructed without mortar or cement. Instead of the interstices being filled with such a binder, the boulders of which the protective barrier is built are firmly held intact by heavy galvanized mesh wire, as shown in the photograph. It withstood the mighty rushes of water without a sign of weakening and saved the main highway heretofore washed out annually. This highway runs parallel with the river along a mountainside and the wall stands between it and the stream. The rubble was laid in tiers or terraces about a foot and a half deep, that at the base twelve feet wide and that on top four feet. The structure is ten feet high and 600 feet long. This wall was built with prison labor by Los Angeles County at a time when cement was obtained with difficulty, and was somewhat of an experiment; but it proved cheaper and fully as staunch as flood structures of stone and cement.

**Galvanized iron mesh held this wall of boulders together, the wall, in turn, holding the San Gabriel River to its course**

The success of this novel means of protection against floods will no doubt lead to its adaptation in many places where efforts to control sudden floods have hitherto proved futile.—By *John L. Von Blon.*

### The Ready-Cut House in France

FRANCE has always been the country of the stone house—the substantial structure built by the industrious Frenchman who thinks not in terms of the immediate future or even of his lifetime, but of future generations. Of course the war has done away with thousands upon thousands of these one-time staunch stone habitations, and the devastated regions must be rebuilt in a more expeditious manner than the old one of stone and mortar with its time-consuming labor.

So the ready-cut house has made its appearance in France. This American invention—the house which can be bought in pieces, already cut to size and fit and assembled according to blue-print—is now popular in France. Our illustration shows several offerings of French manufacturers, recently exhibited in Paris. Despite the fact that these houses are being turned out in large numbers, they have an attractive appearance. They are said to sell at a remarkably reasonable price. But the fact remains that the Frenchman, once he can get back to his normal life, is going to rebuild France with stone houses which he can pass on down to his grand children, long after the wooden houses have disappeared. — By *Ralph Howard.*

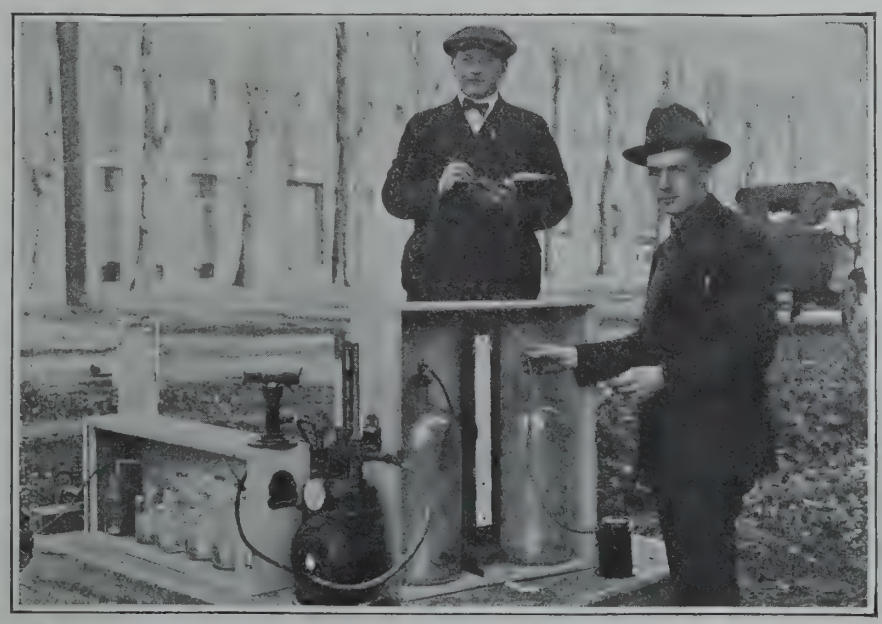
**Ready-cut houses recently exhibited in Paris and sold to the inhabitants of the devastated regions**

### Testing the Air We Breathe

IS the air you breathe pure and is the city in which you live healthy? This is an age-old query and one which often precipitates a controversy between the denizen of the valley and the man who lives on a mountain top. The former is often pitied by the mountain-dweller because of the preconceived notion that the atmosphere of the lower levels is charged with impurities; while the reply of the citizen of the valley is, "Much of your boasted ozone on the mountains is a myth."

While the U. S. Bureau of Mines would studiously avoid agitation of such a mooted question, this Government department has devised an instrument for revealing the quantity of solid matter and the gaseous impurities in the atmosphere. For instance, if there is an excess of smoke, or other extraneous material hovering over your city this apparatus would doubtless answer the question, "Is this super-abundance of smoke, say from a foundry, burdened with impurities which are detrimental to the inhabitants of the city?" The device is in practical use in Salt Lake City, Utah.

The large bottles shown in the photograph are used for detecting and measuring of sulfur dioxide, the apparatus being capable of revealing the presence of one-tenth part in one million. The weather barometer, a part of the equipment, contains a filtering thimble which ekes out the soot and other solid material. The air is measured by the meter, and then passes through the small bottles, in the left of the photograph, which containers absorb the nitrous oxide, ammonia, chlorine and other gaseous impurities. The bottle on the box, to the left, determines the amount of carbon dioxide. A motor-driven vacuum pump, situated immediately behind the boxes, forces the air through the apparatus. The job is complete—the percentage of gaseous impurities in the atmosphere is revealed.—By *S. R. Winters.*



**By means of this array of apparatus these specialists soon determine the fitness of the air which we breathe**

### Making American Roadsides Productive

BECAUSE the American roadside is an unsolved problem, and a big one, the announced intention of the highway department of an eastern State to plant fruit and nut trees along the roads, in an experimental way, challenges interest. In addition, provided the coöperation of the State Department of Agriculture can be won, alfalfa-growing enterprises will be launched. The state is New York—the highway commissioner, Frederick S. Greene.

The objects in view are several. There is the obvious one of beautification. The tree-lined highway is soothing and attractive. Second, there is the avoidance of an economic waste. The roadside land at present unproductive in the United States is enormous. Roadside weeds are a positive evil throughout the nation. The third object in view, of a different character, is understood best by highway experts. It is the protection of the built road. Trees tend to lengthen the life of a road because they shade it, and prevent rapid expansion and contraction.

It is a common practice in Europe to plant fruit trees along highways. The fame of certain districts in which cherry trees have been thus used has been spread all over the world. In the United States, aside from planting within villages and cities, the only regulated work of this character at all parallel is seen in apple-lined roads of the Northeast. When the American apple industry was a mere infant, and most orchards were a sideline on general farms, it became a common practice to plant apple trees in a single row along the walls and fences which bordered highways. These trees were inside the fence, yet they utilized the roadside in a practical manner, for half their root system, and a large part of the plant food they used, was in roadside soil. Tree-lined roads of this character are still to be found.

The road allowance generally in this country is liberal, and often manifested in excess of traffic requirements. The roadside land disused thus created may be worth as little as $5 an acre, as in some eastern rural sections which could be enumerated, or a matter of $300 or more an acre, as in some fertile farming sections of the Middle West. It may be land worthless for agriculture, or the most fertile of soils.

The New York plans are frankly tentative. They may culminate in a leasing system under which the roadside production of certain areas is let to farmers, or they may end in the conclusion that any administration of roadsides must be entirely public. It is suggested that, carefully handled, the roadsides might contribute substantially to the cost of road maintenance.

In the well-settled farming counties of the Middle and Far West, there is often a crying need for well-regulated administration of the roadsides. Especially has this been felt the past two seasons, when hay and pasturage being high in price and scarce called general attention to the resources of the highways.

In some communities, the farmers of a neighborhood would turn their stock out on the roads; the man owning the most stock derived the most good. In some other places, it was illegal to pasture stock on the highways, even in the care of a herder, and no provision for utilization of the roadsides was made.

# The America's Cup Races

## Notes on the Contests for 1920

By J. Bernard Walker

THE struggle of 1920 will go on record as the keenest in the history of the America's Cup. Perhaps this statement would be closer to the truth if the "Resolute" and "Shamrock" were being sailed boat for boat; for the races had not proceeded very far before yachting men were convinced that "Shamrock's" chances of winning the Cup, subject to the heavy burden of over seven minutes' handicap, were very slight.

Nicholson, the designer of "Shamrock," has stated that these races are practically tuning up races for "Shamrock," and it is certain that what little sailing she did against the 23-meter "Shamrock" was of little value to her; this for the reason that she so greatly surpassed the older boat on every point of sailing. "Shamrock" never had an opportunity to try herself out against a boat of her mettle until she met "Resolute." Positive proof of this is seen in the fact that she was able to beat the 23-meter boat by something like fifty seconds to the mile, going to windward, on which point of sailing if the wind holds true, she seems to be from two to three minutes in 15 miles behind the Herreshoff craft.

Weatherliness has always been a distinguishing feature of Herreshoff's designs no matter what the size or type, whether knockabouts, 30's, 50's, or 90's, or whether sloops or schooners; and it is because "Shamrock IV" was so greatly superior to the famous 23-meter boat in windward work that there seemed to be a fighting chance of her pulling out the necessary seven minutes' lead, with just a little over to score a win.

"Shamrock" foots fast enough on every point of sailing, and the fact that she is able to reach the outer mark only a minute and three-quarters behind "Resolute" in a turn to windward of ten miles, proves, to our thinking, that she must be footing faster through the water than "Resolute." Just how great is the difference in pointing, we do not know, but it must be at least a quarter of a point to put her so far to leeward on a board of any length. It is possible that Nicholson, if he had the time, could make such changes in the sailplan and in the lateral plane as would enable "Shamrock" to lie as snugly to the wind as does "Resolute"; though we are inclined to doubt it. If this could be done it is quite possible that in a series of a dozen races in winds that held true, the result might be a tie between the two boats.

Since we last went to press the "Resolute" picked up another race, thus making the series a tie. This fourth race, held over a triangular course, was sailed in a freshening breeze, the first ten miles being laid to windward. On this leg, "Resolute" pulled out a lead of one minute and forty-seven seconds. The second leg consisted of ten miles of broad reaching, and had the wind held true, there would have been another ten miles on a broad reach to the finish. Since this was generally considered to be "Shamrock's" best point of sailing, it was thought that she might save from four to five minutes of her allowance. But to the surprise of everybody on board the yachts which followed the races, her gain in ten miles was only forty-three seconds. In view of the fact, however, that this leg was sailed at a speed of slightly over twelve knots, the gain of three-quarters of a minute was very creditable. Three-quarters of a minute gain at that speed would, of course, be considerably greater if the course were covered in light winds that would require the whole six hours to complete the course.

On the final leg, "Shamrock" continued to gain and seemed to have pretty well made up the remaining minute that "Resolute" had gained to windward. She was so close that "Resolute" had to luff out to prevent her passing. At this time the meteorological conditions were most unusual. A white fog bank was moving up against the wind to meet the yachts, and a black squall seemed to be about to burst upon them from to windward. The skipper of "Shamrock," realizing that there was no chance of picking up his seven minutes of handicap, determined to play safe and took in his club topsail. "Resolute," however, held to hers, and as the black squall failed to materialize and the boats ran into a comparative calm, "Resolute" was to the good as regards canvas for the rest of the race. After the wind had headed both yachts, it finally settled down to a quarter which enabled "Resolute" to come home with her balloon jib carrying a good rap full. She gained on the last few miles of this leg two minutes and fourteen seconds, winning the race by three minutes and eighteen seconds, or nine minutes and fifty eight seconds, corrected time.

" Shamrock IV " leads " Resolute " across the line in a dead heat; but " Resolute " wins by her 7 minutes 1 second time allowance

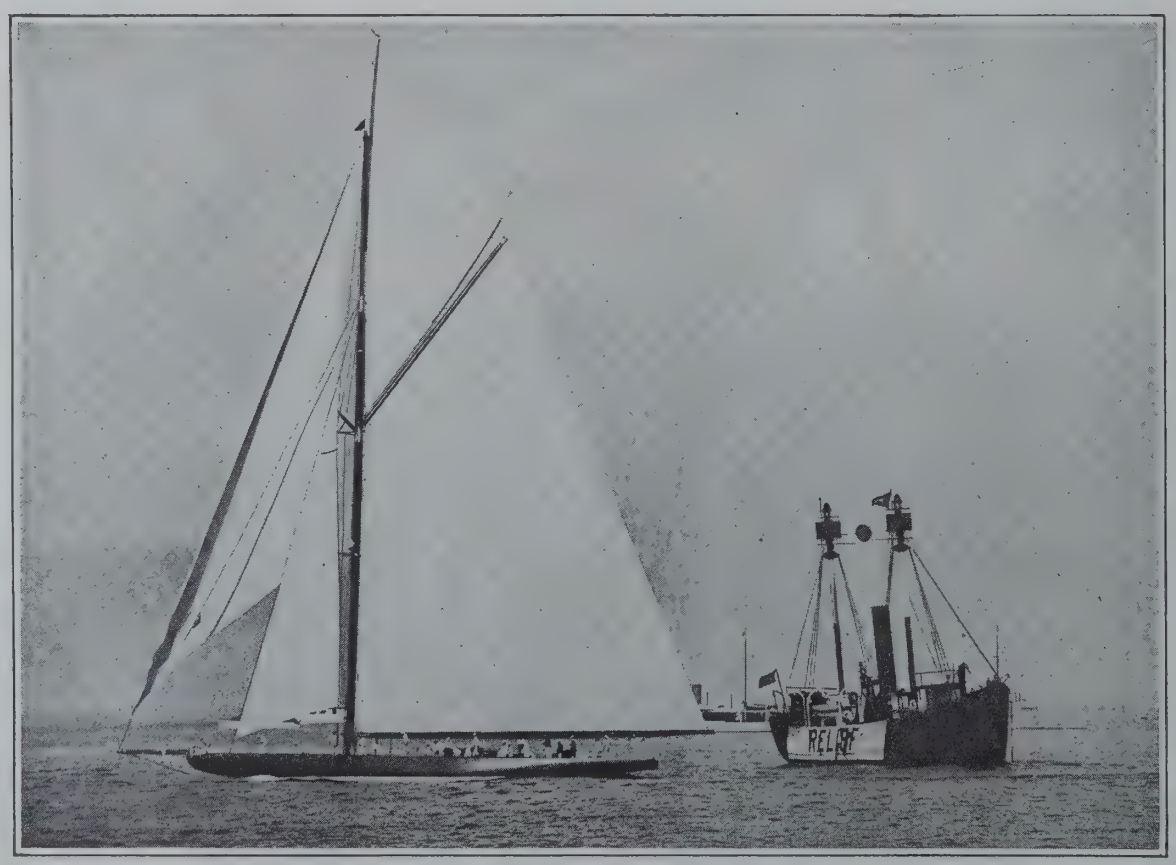
**Finish of third race—30 miles windward and leeward**

The two boats were now tied with two races for each. The earlier attempts to pull off the deciding race were disappointing to the point of exasperation. On Saturday, July 24th, there was a splendid breeze of from 22 to 28 knots' force, but unfortunately, it was accompanied by a short and rather heavy sea caused by the wind meeting the tide. Both boats labored so heavily when reaching over the few miles from Sandy Hook to the Lightship that by mutual agreement of the skippers and the Race Committee the race was postponed.

The incident is a significant commentary upon the unseaworthiness of these modern racing craft, whose scantling has been skinned down to the last ounce of weight, and whose towering rig, with its hollow spars and attenuated standing gear is poorly constituted to stand the dynamic forces which result from a squally wind and a short, snappy sea. As Sir Thomas Lipton's steam yacht, with guests aboard, steamed back inside the Hook to speak to "Shamrock IV," she passed the 23-meter "Shamrock." "There," said one of the guests, a grizzled yachtsman who has been in the game for over thirty years, "there's a boat that would have fairly reveled in such a day as this." But the 23-meter "Shamrock," as we have already recorded in this journal, was built under a rule which seeks to combine the fast racer with the comfortable cruiser. Her scantling and masting had to be built to strict specifications, and more than that, before she could enter the races she had to be given an A1 classification by Lloyd's, based upon these specifications.

Yachting nations of all the world, realizing the then existing conditions tended to produce such boats as "Resolute" and "Shamrock," recently got together and drew up a rule which is a modification of the rule under which "Shamrock" was built. An earnest invitation was sent to the United States, asking us to join in this movement, and Mr. Burton, who sailed "Shamrock IV," came to this country to further the request. But unfortunately, as we think, the representatives of our leading yacht club refused to enter into any such association. Had we done so, any yacht of any nation would be eligible to enter the local regattas

(Continued on page 140)



" Shamrock IV " passing the Ambrose lightship, with a lead over " Resolute " of 9 minutes 27 seconds actual, and 2 minutes 26 seconds corrected time

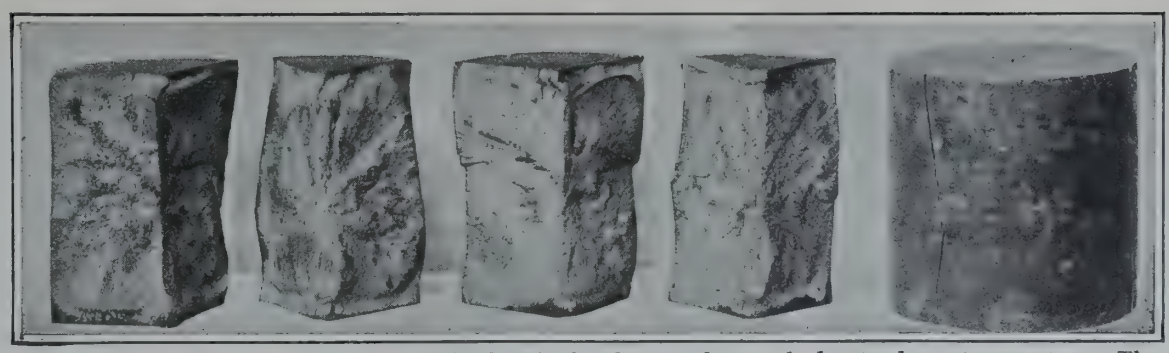
**Finish of second race—30 miles triangular**

## When Steel Explodes—and Why

WHO ever heard of a chunk of steel exploding? None of the metallurgists in the General Electric Research Laboratory ever had until one May day this year. On that day Herman Winkler, an employe busy hardening three slugs of ordinary Sanderson carbon steel to be used as plungers in making genelite, a new self-lubricating bearing metal, drew a slug out of the electric furnace at about 750 degrees Centigrade, quenched it in a tank and then took it in his left hand. With a rasp in his right hand he was about to test the slug's hardness when someone distracted his attention. In that moment the end of his rasp tapped the flat end of the slug.

"It flew to pieces with a crack like a pistol shot," said Mr. Winkler. "One chunk went by my ear, another went straight up and the remaining two dropped into the sink. It was peculiar. My hand was merely bruised a little bit."

The only explanation advanced for the phenomenon is that the slug, which was about four and a half inches long and four in diameter, cooled a degree too quickly on the outside and the heat-expanded core exerted a surface tension so unusual that the slightest touch at that exact moment produced the violent fracture. The other two slugs from the same bar that day got what appeared to be exactly the same treatment, as have thousands of other steel slugs in times past, and not one ever responded as this one did. The photographs show there was no flaw in the metal, but the lines of core strain are obvious.



**The first four fragments show the explosive break of carbon steel, quenched to too low a temperature. The fifth specimen shows carbon steel block broken by hardening strains**

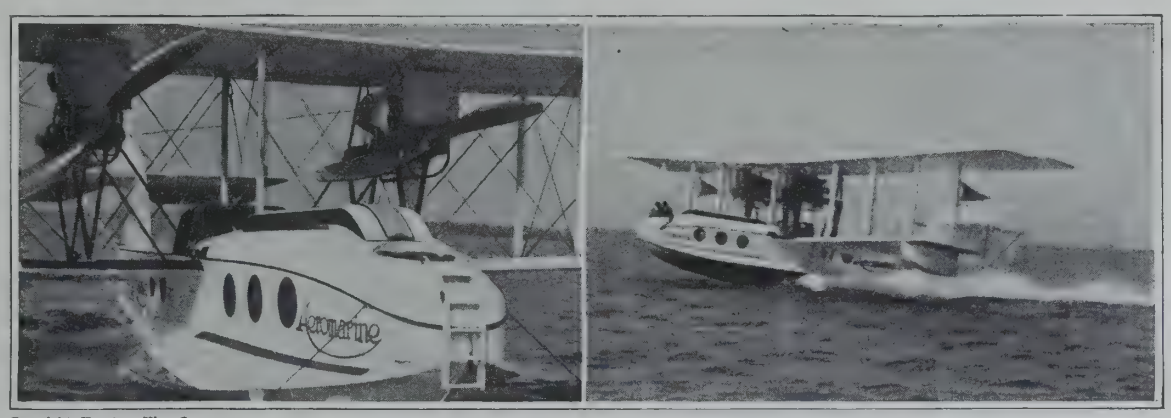
## Our Latest Aerial Creations

WHATEVER may be said regarding the dumping of foreign airplanes in these United States, the fact remains that we are pretty well able to take care of our aerial needs both as regards quality and quantity. In fact all that seems necessary just now is for the Government or the public at large to give the aircraft constructors proper support in order that they may hold their equipment and personnel intact.

Two of our recent aerial creations are the huge L.W.F. plane and the sturdy Aeromarine cruiser, both of which are shown in the accompanying illustrations. These large aircraft compare most favorably with those of England and France, and are only surpassed by the all-metal giants of Germany. For that matter Germany—and we have reiterated this statement over and over again in these columns in the spirit of scientific impartiality—has a monopoly in all-metal construction for some reason which is hard to fathom.

The L.W.F. giant can be briefly described as a biplane with two fuselages and a central nacelle, driven by three Liberty engines with tractor screws. The wing spread is 105 feet. The machine has been purchased by the U. S. Army for use as a bomber.

The Aeromarine cruiser is designed to carry fourteen persons. It has a wing spread of 103 feet, weighs eight tons, and is driven by two 400-horse-power Liberty engines. The main cabin accommodates nine, while the smoking compartment seats five. The equipment, which is quite complete, includes a buffet.




Copyright, Keystone View Co.

**Close-up view of the cabin and engines of the Aeromarine Cruiser, and the huge flying boat speeding along on the water prior to taking the air**

**How the huge L. W. F. biplane appears when in actual flight with the engines full on**

## Observations on Radio Transmission Phenomena

THE Bureau of Standards has secured the coöperation of the American Radio Relay League in the collection of data for a study of the nature and causes of the fading of radio signals. It has been observed by radio amateurs generally that the strength of signals received from a given transmitting station varies rapidly during very short intervals of time, this variation probably depending upon the weather and various meteorological conditions.

In order to secure simultaneous observation of signals, arrangements have been made for a number of well equipped amateur radio stations, including six transmitting stations and about forty receiving stations, to begin such a series of tests. The six transmitting stations will send out a broadcast message lasting about three minutes each on Tuesday, Thursday and Saturday evening, beginning just after the time signals from the Arlington Radio Station of the Navy. These stations will transmit for their different regions ten minutes apart, and three or four of them will be within the receiving range of each receiving station.

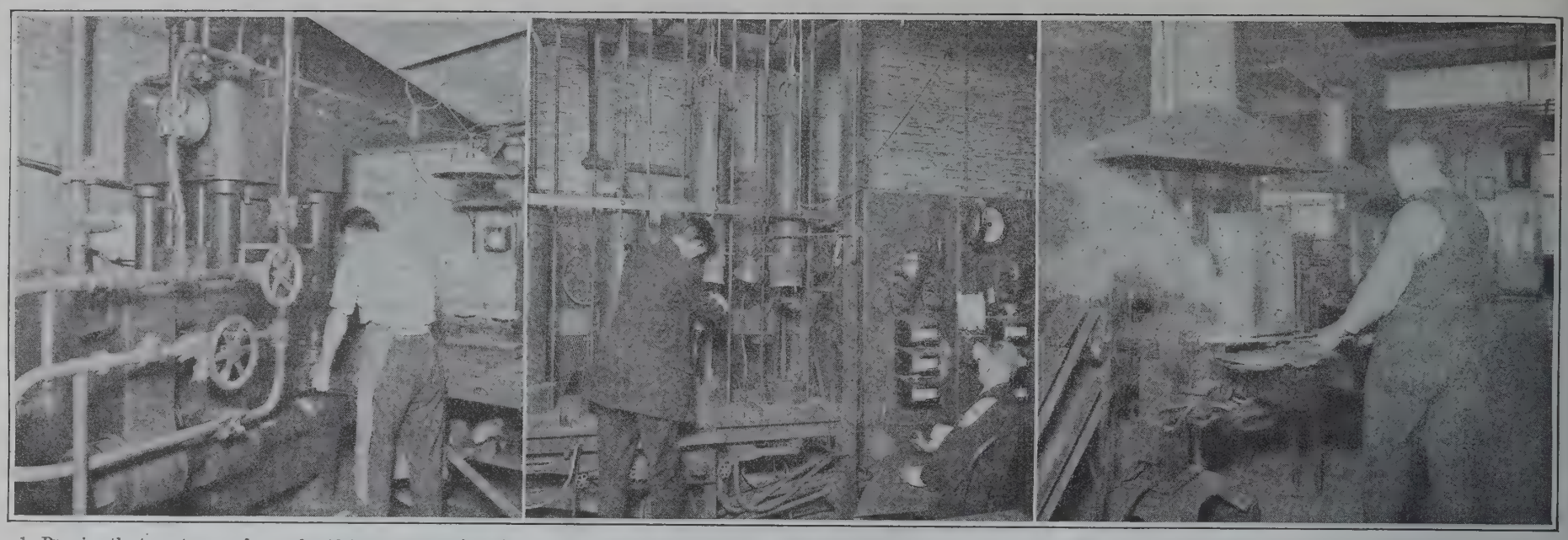
Forms have been provided by the Bureau of Standards on which the operators will record the strength of the signals which they receive, weather conditions, presence of strays or atmospheric disturbances and the general character of radio transmission at the time of each observation.

It is hoped that from this program of careful observations some valuable conclusions regarding radio transmission will be worked out. If the present plan, covering only the northeast part of the United States is successful, a more extensive program may be undertaken during the coming winter.

## Mental Tests in Schools

THE National Research Council announces that the mental tests which were used with striking success in the Army during the war are to be used on a large scale in American public schools. A program of group tests has been worked out which will make it possible to conduct wholesale surveys of schools annually, or even semi-annually, so that grade classification and individual educational treatment can be adjusted with desirable frequency. Prof. R. M. Yerkes is in charge of this undertaking, and the General Education Board is furnishing financial support.

**Two views of the giant L. W. F. biplane, which has a wing spread of 105 feet and which is powered with three Liberty engines**



1. Pressing the tungsten powder, under 16 tons pressure, into blocks that are too crumbly to handle. 2. Putting these slugs into a hydrogen atmosphere for treatment with electric current to improve the cohesive qualities. 3. The red hot tungsten bar passing through one of the many swagers whose revolving hammers chatter on all sides of the bar to bring it to smaller compass.

**From powder that will not stick together to wire of great tensile strength**

# The Romance of Tungsten

## How This Erstwhile Brittle Metal Was Made Available for Lamps

By George Gaulois

A CASUAL look at the filament of the incandescent lamp in your library or at the tiny spark coil contacts on your automobile brings no suggestion of the romance of science which lies back of those devices. It is the romance of tungsten, one of the heaviest of metals, a metal nearly 140 years old but which resisted the efforts of mankind to make use of it in its pure state for about 130 years.

Yet the service pure tungsten has rendered the world in the last decade since it was "conquered" is almost too great for calculation. Tungsten in its various forms reduced America's electric light bill a billion dollars a year and more than doubled the usefulness of the incandescent lamp. Ductile tungsten kept the automobile industry alive during the war. It helped make possible the Coolidge X-ray tube with tungsten targets which tremendously increased the value of the X-ray machine to mankind. With it the pliotron was built so that wireless telephony could be developed to a useful and dependable point. With it the tungar rectifier was created so that owners of automobiles could charge their cars in their own garages by simply plugging into a light socket. With it phonograph needles are being made more than 50 times as good as the steel and the fiber needles, heretofore considered the best that could be produced.

Tunsten bullets might have served in the recent war as projectiles hard enough to pierce the heaviest armor the Germans could put on their aircraft, for a few were made to prove their usefulness in that capacity, but the plan to use them was given up after a less expensive way to accomplish the result was discovered.

Before the war only a few thousand tons of tungsten ore were mined in all the world and the price of raw tungsten ranged around 90 cents a pound; but with the war came a tremendous demand for tool steel hard enough to work at high speed though red hot. Tungsten was required as an alloy to make such steel.

*TUNGSTEN, at once the hardest and heaviest of metals, for a century after its discovery was brittle in its pure state and therefore unworkable. How Dr. Coolidge made it sufficiently ductile for the purposes of wire-drawing, and thereby lopped a billion dollars off the lighting bill of America alone, is the story which Mr. Gaulois puts before us here.*—THE EDITOR.

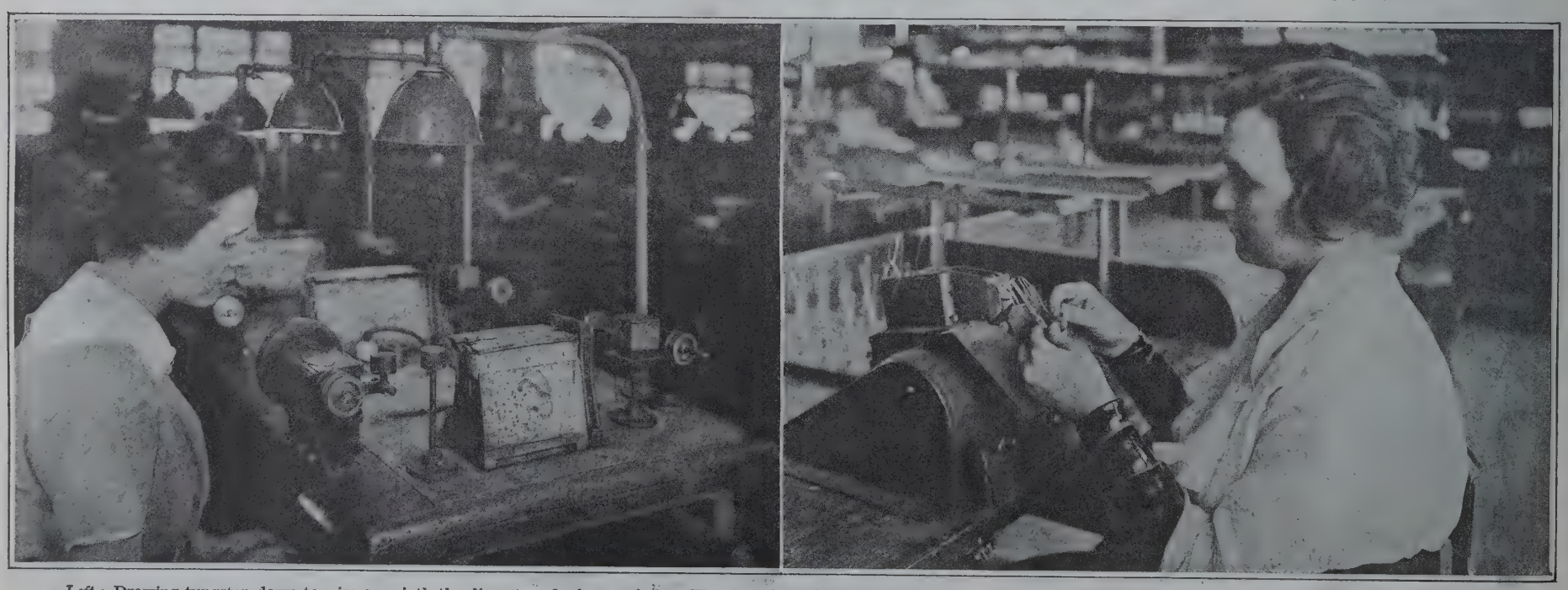
The price rose steeply when the supply diminished before the sudden demand until it reached $7 or $8 a pound. The world's production in 1918 amounted to 35,800 tons. The control over the sources of it was 59 per cent American and 35 per cent British. The price and production slumped with the end of the war until today raw tungsten can be bought for a little over a dollar a pound.

Most of the adaptations for tungsten are due to a discovery made by Dr. W. D. Coolidge, a physicist in the research laboratory of the General Electric Company of Schenectady. He was the first man to find a way to work this most brittle of metals. He made it ductile and thereby hangs this tale.

For about 100 years tungsten had been known before it was put to any use whatever, even as a mere alloy. Its presence was first noticed by Scheele and Bergman in 1781. They found traces of it in a metal called scheelite and coined the name "tungsten" for it from the Swedish "tung," meaning weighty and "sten" for stone. In 1783 three Spaniards discovered tungsten in the mineral wolfram. To this day there is little tungsten taken from any other minerals. It is found in small quantities in Cumberland, England; Limoges, France; and in parts of Connecticut and North Carolina, but most of it comes from Colorado and China.

Extracted from these minerals and pulverized,

(*Continued on page 140*)



*Left:* Drawing tungsten down to wire one-sixth the diameter of a human hair. The thread of tungsten unwinds from spool at extreme right, passes through a lubricant, then into a gas furnace which has a diamond die, and finally on to a receiving spool. *Right:* Winding the fine tungsten wire by hand on the lamp mount

**Making tungsten wire of almost invisible gage for lamps**

**With the exception of the legs and the tail, this potato was found as it is**

## When Is a Potato Worth $140?

FREAK vegetables have always been a source of much interest—and much money, too. The Chinese, for instance, pay high prices for ginseng roots which resemble the human form; indeed, these odd-shaped roots are graded according to their relative similarity, and sold to superstitious Chinese at prices ranging from very little to a good deal more than these roots can ever be worth as far as medicinal properties are concerned.

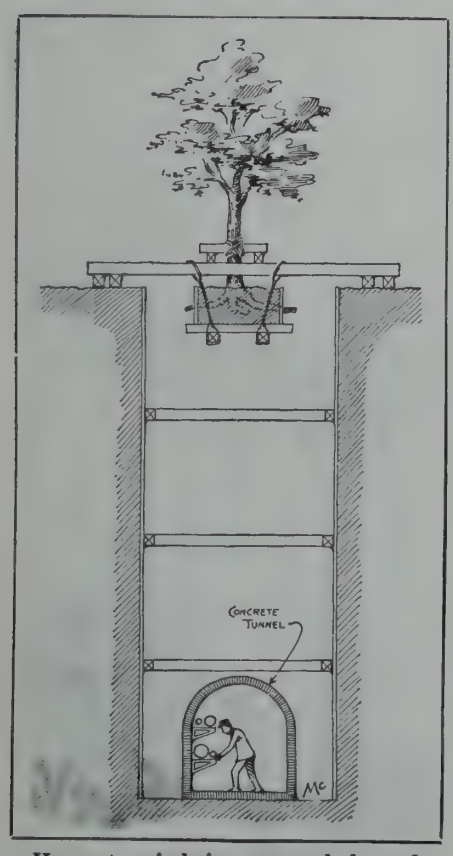
We present in the accompanying illustration a potatoe which brought $140 at a fair in Tacoma, Wash. This potatoe, with the exception of the legs and the tail, is a natural growth, yet its resemblance to a pig could not be better. It was the subject of much interest and many persons took a chance on winning it as the result of a raffle for the purpose of raising money for the boys in the army and navy.

## The Worth of a Tree

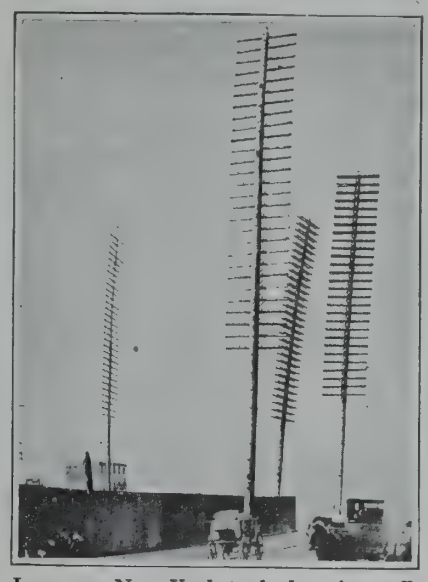
THAT the welfare of a tree is something to consider is being well illustrated on the Capitol grounds at Denver, Col. In surveying for an underground passage way to connect the State Museum with the new executive building a block distant it was found that an elm tree was in line of the proposed work.

The contractor was for cutting it down, or replanting it at least. But no, the results of replanting a tree of any size are not always satisfactory and as trees are being looked upon generally as good citizens, risks are not to be taken. So under painstaking supervision the roots were shored with long timbers, the ends of which rested on the ground at either side of the tunnel line. Under this a platform was then built, suspended basket-fashion from planks and cable spanning the space to provide adequate support.

In excavating for the passage-way a generous portion of the earth was left about the roots of the tree so as to assure their nourishment and safe-keeping. Some thirty feet below this suspended trunk the men are digging and cementing and walling the tunnel, and when it is all done the earth will be filled in underneath the platform, the timbers will be removed and life for this elm, it is hoped, will go steadily on.




**How a tree is being suspended—and saved—while a tunnel is in building**



**Long ago New York took the wires off these poles and buried them under the streets**

## New York's Buried Wires

THE accompanying view is reminiscent of the early days of the telephone in New York City. Some thirty years ago it was the practice to place telephone and telegraph wires on lofty poles and cross-arms just as is now the case in rural communities and even in large cities.

With the most commendable foresight, the telegraph and telephone interests of New York City early in their career decided to place their wires underground. For this purpose special ducts and tunnels were provided under the city streets, and the unsightly poles with their maze of wires soon became a thing of the past. Today New York is a model of neatness as regards wires. Indeed, there are practically no wires to be seen in the city proper, and it is only in the outskirts of the metropolis, where the metropolitan atmosphere is more or less lost anyway, that one comes across telegraph and telephone poles.

## Effect of Oils on Strength of Glues in Plywood

PLYWOOD may be used near machinery and tanks with little likelihood of being dangerously weakened by the action of oil or gasoline on the glue joints. This fact is evident from a test lately completed at the Forest Products Laboratory.

Plywood panels glued with animal, vegetable, blood albumin, and casein glues were immersed for nearly a year in engine oil and gasoline. At regular intervals specimens were removed from the liquids and tested for joint strength. All the glues weakened somewhat during the early part of the test, the animal and vegetable glues more than the casein and blood albumin glues. The total loss of strength in any case, however, was small enough to be negligible under most conditions of service. A glue shear strength of 100 to 125 pounds per square inch is considered sufficient for practically any purpose for which plywood is used. Only in two or three instances did the strength of the casein and blood albumin glues fall below 150 pounds per square inch. Engine oil, castor oil, and gasoline seemed to have practically the same effect on the glue joints.

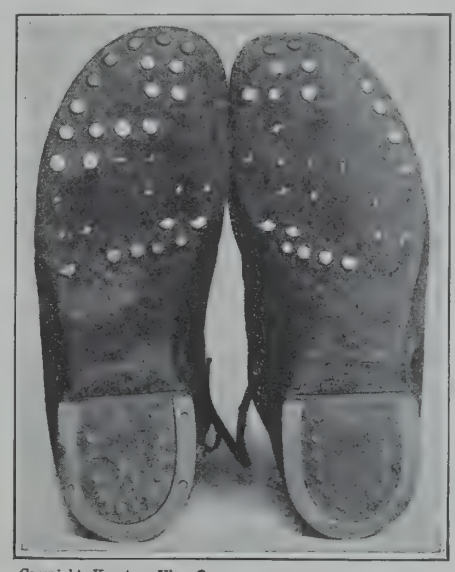
## Wireless Music and News for the Roller Chair Passenger

ASBURY PARK, N. J., has the unique distinction of being the first city in which boardwalk roller chairs have been equipped with wireless telephone and telegraph receiving apparatus so that the passengers are enabled to hear talking and musical concerts from distant stations while the chair rolls merrily along.

W. Harold Warren, who some time ago demonstrated that it is possible to receive wireless telephone and telegraph signals within a steel and concrete bank vault with both inner and outer doors closed and with no external connections to the instruments, is responsible for this new innovation that has already proven so popular at this charming seaside resort.

A small flat "loop" replaces the ordinary aerial and ground connections, and the whole apparatus is so compact that three persons can sit with it comfortably in the chair. The most interesting part of the installation is the fact that the vibrations of the roller chair in motion have no effect whatever on the reception of the signals.

The directional effect of the "loop" is most pronounced, the strongest signals being received when the vertical plane of the "loop" is in the direction of the transmitting station. Signals from stations over 200 miles distant are received with the apparatus.



Copyright, Keystone View Co.

**These hob-nailed shoes have been worn for 90 days with hardly a sign of wear**

## Why Not Hob-Nailed Shoes?

THE Bureau of Standards has been conducting a series of interesting tests on footwear in view of the high price of shoes and leather. One particular test took the form of wearing a pair of hob-nailed shoes for several months in order to determine to just what extent the nails take up the usual wear of the leather. The pair of shoes shown in the accompanying illustration was subjected to ninety days' actual wear by means of a machine devised for such tests. As will be noted the leather is hardly worn, while the hob-nails are practically worn down.

## Using Water for Blasting Rock

A WRITER in a German technical paper describes a hydraulic device for blowing up rocks, and, in particular for demolishing bridge piles and ferro-concrete foundations. It is based on the principle of the hydraulic press; enormous pressures are set up within the rock, which eventually bursts. The pressure is transmitted by a pipe-line to a cylinder 85 millimeters in diameter in which eight pistons may be successively displaced telescopically. The cylinder is inserted into a hole, drilled by an electric drill in the rock to be blown up. The pistons bury themselves in the rock one after another and blow up the rock. The holes take 10 to 15 minutes to drill (they are about 2.5 centimeters deep), and in 5 minutes after that the rock is shattered. It is said that this device has proved successful in mines and quarries where the use of explosives would be dangerous.

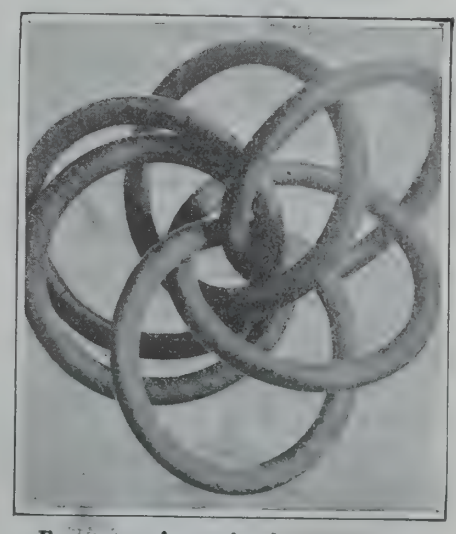
**The loop antenna enables roller chair passengers to listen to music and news reports**

## Try This Whittling Job on Your Pen-Knife

A MASTERPIECE of whittling has just been completed by A. T. Cook of Hyde Park, N. Y. The rings shown in the accompanying illustration are cut from a solid piece of wood and are said to form the most complex and difficult piece of whittling ever accomplished with a jack-knife.

But the aforementioned claim is a difficult one to defend; there have been many remarkable pieces of whittling shown and described in these columns during the seventy-five years this journal has been issued.

The rings here shown are so whittled that each one passes through all the rest, thus complicating the work of making them. Mr. Cook, so we are told, has been whittling more or less for forty years, and considers this piece of work his best achievement.



**Forty years' practice in whittling is represented in these rings cut from a single piece**

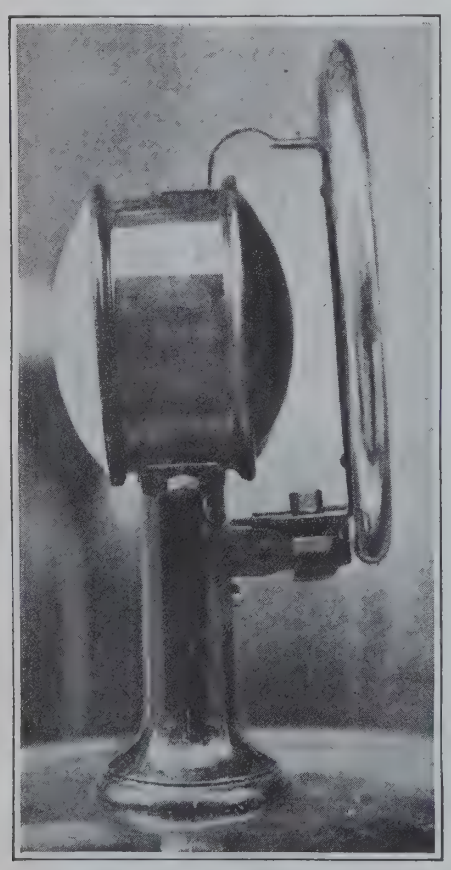
# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

**A charge of sawdust burns twelve hours in a stove invented by an Englishman**

## A Sawdust Stove for Coal-less Europe

THE coal shortage which many of the European countries face this coming winter has not failed to spur inventors in the direction of new fuels and stoves. One of the most recent attempts to solve the heating question is presented in the accompanying illustration, and consists of a special stove which burns sawdust. The stove consists of a cylindrical casing provided with suitable holes for draft purposes, and a container which is packed with sawdust as shown. Once ignited, the tightly packed sawdust is said to burn slowly and evenly, giving considerable heat. A single charge of sawdust burns twelve hours. The action, we are told, is very much the same as coal as far as smooth burning and the intensity of heat are concerned.



**A mirror and parking light in one for the motor car**

## Difficulties of the German Paper Industry

ACCORDING to a recent issue of *Kölner Zeitung*, the German paper industry is seriously handicapped by the scarcity and increased prices of raw materials. This is particularly true of old paper and rags, which are extremely difficult to obtain, and have reached a price which appears unjustified. It is believed that old paper and rag dealers have been holding their supplies to drive prices up. The demand is very great and constantly increasing in spite of the fact that consumers believe present prices cannot continue. The cellulose plants in eastern Germany, which have been forced to suspend production for some weeks owing to the shortage of coal, have recently resumed operations, and it is hoped that renewed deliveries of cellulose will help to drive down the prices of old paper and rags. Straw, which is used in large quantities in the German paper industry, is now quoted at 55 to 60 marks per 100 kilos, but this price is expected to fall in the near future. It is hoped that this will also have an effect on the prices of other raw materials. Wages in the industry have risen over 100 per cent since December, and the cost of coal, chemicals, dyes, and other raw materials has risen in like manner. Manufacturers have therefore been forced to increase the price of paper to a point where the demand is seriously affected. Unless the cost of raw materials falls very soon the industry will undoubtedly suffer.

## A Mirror by Day—A Light by Night

IN order to comply with the laws of many States which require the car owner to equip his car with a mirror on the left front mudguard and to keep lights burning when his car is parked at night, an ingenious inventor has recently introduced a combination mirror and parking light shown in the accompanying illustration.

During daylight the mirror is held in the position shown in the illustration, always ready for use. Its position on the mudguard gives it an ideal field of vision. At night when the car is to be parked or left standing the mirror is dropped down to the horizontal position and the light is flashed on. The front lens of the lamp is white, while the rear one is red. In this manner the automobile shows a white light in front and a red light toward the rear, in compliance with the State laws. Incidentally—and this is a very powerful argument in favor of this new device—there is a saving of considerable current when operating this light in place of the usual equipment. Indeed, the inventor claims that the usual lighting—two headlights and the tail light—requires several times the current used by his device for accomplishing the same purpose.

## What Did the Dentist Put in Your Mouth?

LIKE battering the head of a rivet with constant tapping until the tiny bit of metal is flattened, similarly the point of your tooth (for instance, in chewing beefsteak) from an opposite jaw applies a load of several thousand pounds to the square inch on the amalgam or teeth fillings. The intensity of the pounding is caused by the restricted area in which the point of the tooth operates.

What is the relative wear on your teeth fillings, what is the crushing strength exerted upon amalgam, and what influence has ice water and hot foods on the artificial patchings in the cavity of your tooth? These questions are not insignificant when a visit to the dentist is convincing proof that dental material figures in the budget of H. C. L. So the U. S. Bureau of Standards devised a special apparatus for testing the wear and tear on fillings when subjected to constant pressure. Not that there should be any release of the tension placed on the amalgam in the mouth—as this would result in bad digestion—but the experiments sought to determine the durability of the material entering into the construction of teeth fillings.

It was discovered that by rapid-fire eating—when the crushing load is constant—the pressure exerted on the teeth fillings is in excess of 22,000 pounds to the square inch. This rate was indicated when the amalgam was crushed quickly, within three minutes—the dental material had set for 48 hours. However, by applying a constant impact of 3,200 pounds, one-tenth of the former crushing load, it was possible to crush some of these same amalgams in 20 hours.

With the foregoing facts established, comparative flow tests were made. Within two hours after packing, a load of 3,200 pounds to the square inch was applied to a specimen of fillings 4 millimeters in diameter and 8 millimeters long. The new type of apparatus used, specially designed for the purpose by the Bureau of Standards, consisted of a micrometer with a weight pan attached at the top of the upright rod or plunger. The two ends of the specimen of fillings were cut at right angles to the axis and inserted in the jaws of the micrometer. As the amalgam is subjected to pressure by weight applied at the top of the rod the indicator moves around the dial. The difference of readings reflects the amount of flow. An air cushion plunger in the micrometer obviates possible injury to the instrument if the fillings fracture abruptly.

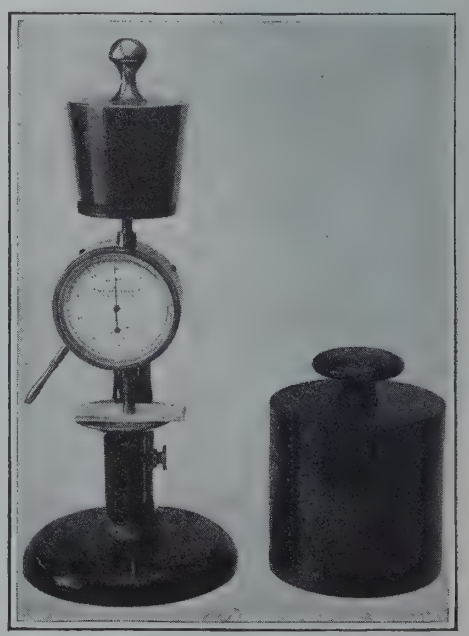
Two hours after amalgamation and packing, the specimen was subjected to a pressure of 3,200 pounds to the square inch, being compressed 4 per cent in thirty minutes. Most amalgams will withstand this test well at one hour and a few at 30 minutes after packing. It was concluded that the qualities of failure seem to be inherent in some dental material, these failures betraying their weaknesses as readily after 48 hours as after 30 minutes. The chemical composition of one's teeth fillings vary from 45 to 69 per cent silver and from 0 to 5 per cent zinc, copper and tin making up the balance.

Samples of fillings showed irregular behavior when subjected to a temperature of 80 degrees Centigrade, the conclusion being that such temperature may exercise injury to the amalgam or change its physical properties. Tests with ice water at a temperature as low as 5 degrees Centigrade and with hot foods at temperature as high as 60 degrees Centigrade indicated no excessive pain on adjoining vital teeth. Excessive percentage of copper in teeth fillings will produce discoloration.

**When the vanity bag is opened the Jack-in-the-Box shoe cleaner is ready for use**

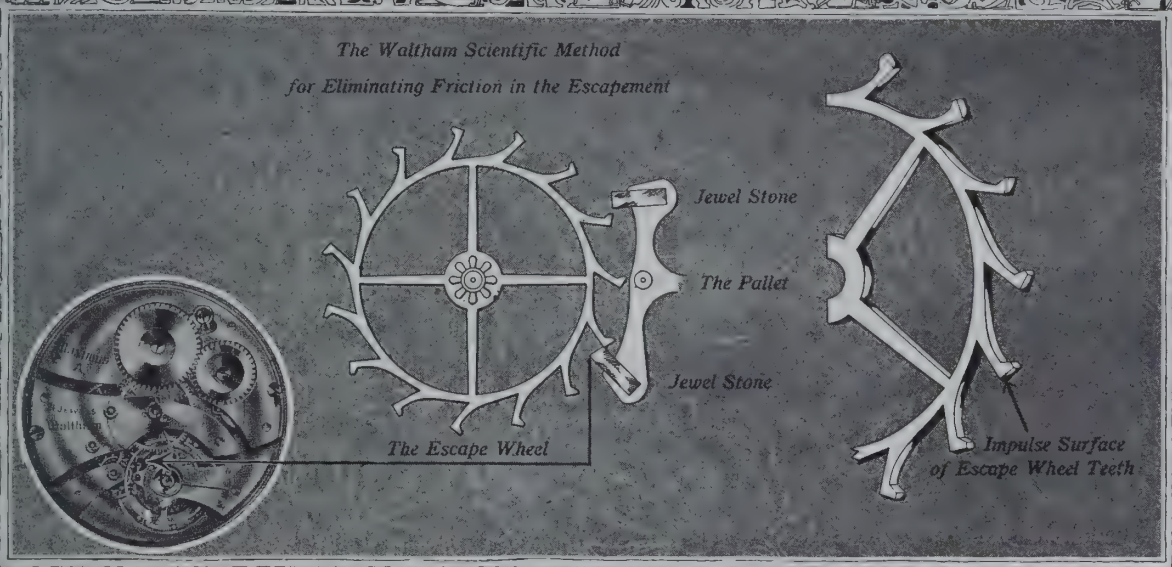
## A Jack-in-the-Box Shoe Cleaner for the Vanity Bag

THE latest addition to milady's vanity case is the Jack-in-the-Box shoe cleaner, shown in use in the accompanying illustration. A strong spring is conveniently camouflaged in the dainty vanity case or bag so that normally there is nothing to indicate that the wearer has conspired to get along without the ubiquitous shoeblack. However, upon opening the compartment containing the Jack-in-the-Box shoe cleaner, the spring jumps out with the pad at the free end. The shoe cleaner can then be used in the manner shown for dusting and cleaning the shoes, after which the spring is pushed back into the vanity bag.



**A micrometer arrangement whereby teeth fillings can be tested**

# PROOF




## THE MOST SCIENTIFICALLY BUILT WATCH IN THE WORLD

The Waltham Scientific Method for Eliminating Friction in the Escapement
Which Means Accurate Time-keeping and Dependability of Your Watch

THE pallet stones (pieces of selected Ruby or Sapphire perfectly formed in rectangular shape and highly polished) check the power which comes from the mainspring in your watch and then release it 18,000 times or beats per hour.

In these governing functions of the escape-wheel an impulse is given to the balance wheel, which is transferred in governed movement, called Time, to the hands of the watch.

Think, for a moment, of the possibility of friction, where the pallet jewels slide over the impulse surface of the escape-wheel teeth (illustrated above) 432,000 times every twenty-four hours!

Here was an opportunity for Waltham invention to minimize friction practically to the vanishing point. And friction is the most insidious and dangerous enemy to correct time-keeping in the works of a watch.

After years of experiment and development, Waltham invented a machine equipped with a diamond cutter which not only cut the diameter of the escape-wheel to its exact size, but left the impulse surface of the teeth so perfectly shaped (rounded) and highly polished that when the face of the pallet stones (jewels) slid across that surface, friction was practically reduced to its ultimate minimum.

It can readily be seen that this development of the diamond cutter has given the Waltham Watch a positive and valuable advantage in time-keeping and unvarying performance.

The ordinary method of making an escape-wheel is to polish with some polishing compound which being composed of gritty elements cannot be used without particles of grit becoming embedded in the polished surface. This in time roughens the surface of the pallet stones, eventually causing greater friction and consequent variability of time-keeping.

The Waltham Scientific Method, then, of cutting and polishing with a cutter made from a diamond is another hidden, yet vitally important, superiority in the "works" of a Waltham Watch which provides an unanswerable reason why your watch selection should be a Waltham.

**The Riverside**
The most dependable moderate priee watch in the world
$75 and up

*This story is continued in a beautiful booklet in which you will find a liberal watch education.*
*Sent free upon request. Waltham Watch Company, Waltham, Mass.*

# WALTHAM

## THE WORLD'S WATCH OVER TIME

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

### Pertaining to Aeronautics

DIRIGIBLE AIRSHIPS.—J. JANDA, c/o U. S. Navy Recruiting Station, Tulsa, Okla. Among the objects of the invention is to provide a dirigible airship having a plurality of independent or separable gas bags or equivalent buoyant receptacles so coupled together during normal operation as to operate as a unitary ship, but which in the event of serious damage to one of the bags it may be separated from the remaining bags, permitting the latter to continue on their course for further operation. A further object is to provide a large aircraft for the convenience of a number of aeroplanes and for the despatch of such planes from the parent ship.

PARACHUTE.—J. W. TAYLOR, 12310 Miles Ave., Cleveland, Ohio. The invention has for its object to provide a device especially adapted for supporting an illuminant packed in a suitable container, and in the form of a projectile adapted to be fired from a gun and exploded at a predetermined point, to release the illuminant and the parachute wherein the parachute is so arranged as to relieve stresses imposed thereupon in retarding the velocity of the illuminant at the high velocity at first obtaining.

### Electrical Devices

EXTENSION BASE LAMP BULB.—P. P. HEIN, c/o Bory, 444 E. 79th St., New York, N. Y. Among the objects of the invention is to provide an electric lamp bulb having an adjustable or extensible base whereby when the base is locked in the reflector socket the filament or bulb portion proper may be adjusted axially toward or from the socket anchorage for focusing purposes. The device is adapted to be fitted for use in connection with any ordinary reflector, the socket of which has a fixed position with respect to the reflector.

### Of Interest to Farmers

HAY COCKING MACHINE.—J. A. FRANCE, Sault Ste Marie, Mich. The object of the invention is to provide an arrangement of hay cocking machines wherein hay is gathered up and deposited on a platform for discharging after having been arranged in a cock of the desired size. A further object is the provision of a machine for gathering hay into hay cocks formed with the lifting mechanism having supporting ropes normally sagging between adjacent cleats for receiving the hay from a hay rake or gatherer and discharging the same at a given point.

GRAIN STORAGE BIN.—L. H. DICKELMAN, Forest, Ohio. The invention relates to storage bins more particularly for storing rice. An object is to provide a portable grain bin which is composed largely of sheet metal, having means for automatically ventilating the rice or grain thereby preventing the overheating of the same and obviating the necessity of "turning over" the grain or handling it otherwise to prevent overheating, at the same time preventing the admission of sufficient air containing moisture, which might be detrimental to the grain.

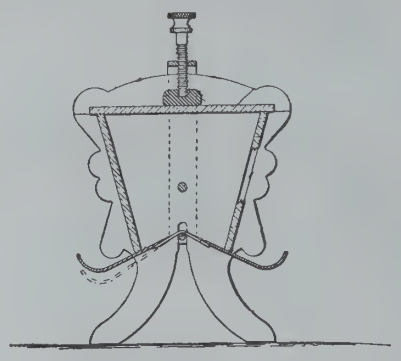
### Of General Interest

DISPLAY CARTON.—R. VAN IDERSTINE, 286 Park Ave., Newark, N. J. Among the objects of the invention is to provide a box construction comprising a plurality of interfitting or telescoping parts, which will at all times provide a connection so as to prevent the possibility of the parts becoming separated or lost, but still to permit free relative movement between the parts and to permit the parts to be readily arranged in a position most effective for purposes of display.

PRINTED BOOK.—H. W. HAIGHT, Cranford, N. J. The object of the invention is to provide a printed book or block for school purposes, more especially designed to restrain a scholar from looking ahead of the page being used. In order to produce the desired result the leaves of the book have applied thereto a fastening means such as glue or other adhesive substance to fasten the leaves along the top, bottom and sides, the fastening means having an interrupted portion to allow the insertion of a paper knife or other tool between the adjacent leaves.

COMBINED HANGER AND FRAME PROTECTOR.—J. GREENWALD, 940 3rd Ave., New York, N. Y. This invention relates particularly to picture frames. The object is to provide a corner piece which cannot be seen from the front, but which will protect and reinforce the frame in such a manner as to prevent separation while at the same time presenting a construction wherein a suspending cord may be readily secured thereto.

DELIVERING APPARATUS.—M. BONO, 60 E. Houston St., New York, N. Y. The invention relates to a delivering apparatus, and more particularly to a sanitary receptacle especially adapted for delivering toothpicks. It



A TRANSVERSE SECTIONAL VIEW, PARTLY BROKEN AWAY

is one of the primary objects to so construct the device that its delivering mechanism may be adjusted to operate to deliver one or more articles as desired. The receptacle cover is retained in place by the adjusting means of the delivering mechanism.

CARD FILE.—W. L. DINSMOOR, 925 Geary St., San Francisco, Cal. More particularly this invention has in view to produce a file employing index cards on spindles and so arranged as to provide a convenient means for keeping a file of business cards of patients or clients of professional men; however the device is adapted for other purposes of filing, or for holding calendar cards.

DOLL.—M. J. DUFF, 75 Hadden St., Bridgeport, Conn. The primary object of the invention is to provide a figure toy and construct the same in such manner that any one of a plurality of different expressions for the face may be obtained. A further object is to construct the figure entirely of cardboard, paper or the like, thus greatly decreasing its cost of manufacture.

PROCESS FOR MAKING NON-INTOXICATING BEVERAGES.—W. WILHELMY, SR., 139 N. Clark St., Chicago, Ill. This invention relates to the manufacture of non-intoxicating beverages with nearly the usual equipment of a modern brewery, without the use of special apparatus. The process consists of adding yeast to thin wort containing extract of hops at a moderately high fermenting temperature, allowing to stand for a predetermined period, reducing to a cooling temperature, and allowing to stand at such temperature for a specified time, adding a body giving substance and finally carbonating the beverage.

CHAIR SWING,—J. W. SPARKS, Clear Lake, Iowa. The invention has for its object to provide a chair swing which will be comfortable for a child, which will prevent the child from slipping or falling out, and which can

A VIEW IN SIDE ELEVATION PARTLY IN SECTION

be collapsed and packed in a small space when not desired for use. A further object is to provide a swing of the character stated, which can be adjusted to the height desired, and which will be strong and durable.

CLASP.—S. SCHRANTZ, 5938 Niverna Ave., St. Louis, Mo. This invention relates particularly to clasps for spectacle cases. An important object of the invention is to provide a clasp for spectacle cases which will be so constructed and disposed on the spectacle case as to be highly effective to retain the case in the desired position and at the same time will not present a projection likely to cause annoyance or discomfort to the user.

PRINTING FRAME.—D. F. YOUNKIN, 800 Coleman Ave., Johnstown, Pa. This invention has for its object to provide a frame adapted for all classes of printing, but especially for printing from tracings, for instance, of greater length than the frame, the frame being so arranged that the tracing may be drawn through the same to permit every portion to be printed from, and wherein a form of lock for the frame is provided.

SWAGGER STICK.—J. M. CALLAHAN, 17 "S" St., N. W., Washington, D. C. The invention relates generally to swagger sticks and more particularly to a stick comprising a handle having an engaging implement at one end in the form of a hook for the purpose of permitting of practical use of a device of this character in many instances of ordinary every day life, for instance, engaging the hand strap rail, or seat rail of a street car or other objects encountered, and in the nature of disease spreaders.

APPARATUS FOR FORMING GUN BARRELS.—W. F. COLE, 901 Amicable Bldg., Waco, Texas. The invention relates particularly to the manufacture of gun barrels having smooth bores of elliptical shape, twisted uniformly and adapted to replace gun barrels having the usual internal rifling. An object is to provide an apparatus whereby a cylindrical tube may be slightly flattened along a uniform helical line for either its entire length or the greater portion of its length.

DRIP DEVICE.—W. H. GROVER, Bay Shore, N. Y. The invention has for its object to provide a device more particularly for dripping fruit and the like in the manufacture of jelly. A further object is to provide a device which will be entirely sanitary, which will protect the drip from contact with dust, dirt or insects, which can be conveniently located at any point desired, and which can be folded and packed in a small space when not in use.

MATCH LIGHTER.—E. J. FISHER, 109 Whitestone Ave., Flushing, L. I., N. Y. This invention aims to provide a device whereby matches other than safety matches may be readily lighted. The device is especially intended for use in hotels and stores; it is extremely simple in form, economical in manufacture, can be placed anywhere and be an ornamentation, and can be utilized in the capacity of an advertising medium.

### Hardware and Tools

SCISSORS.—C. R. STORZ, 980 Greer Ave., Brooklyn, N. Y. The invention relates to scissors generally, but having particular advantages when embodied in surgical scissors. The object is to provide a scissors with removable cutting blades immovable in position, and providing for the convenient placing and removing of the blades. Among the advantages are that the blades can be replaced by new ones for approximately the cost of resharpening, also material may be used for the blades having the highest cutting quality and which for technical reasons cannot be used for the body.

FAUCET.—A. LANDGREBE, 1724 Barnes Ave., Van Nest, Bronx, N. Y. The invention has particular reference to faucets adapted to close automatically. Among the objects is to provide a faucet of a construction adapted to be manufactured mainly of glass or other analogous sanitary material. A further object is to provide a faucet comprising a valve seat, a valve or its equivalent, and means adapted to be operated either in front or above the delivery nozzle to manipulate the valve.

VISE.—L. H. DALLARD, 110 Convent Ave., New York, N. Y. The invention relates more particularly to vises of the quick adjusting type. The object is to provide a mechanism by means of which the jaws may be readily opened to any desired adjustment without the necessity of rotating the driving screw, the invention being provided with a driving screw which is disengaged from the operating mechanism.

NUT LOCK.—B. G. PATTERSON, 1210 W. 28th St., Oklahoma City, Okla. An object of the invention is to provide a simple one-piece nut which can be manufactured at low cost, which shall be substantially the same dimensions as standard commercial nuts and which shall be capable of being locked in position upon a bolt by screwing it tightly against a load surface. Another object is to provide a self-locking nut that can be quickly applied and which can be repeatedly used without injury to either the nut or the bolt upon which it is placed.

### Machines and Mechanical Devices

CENTRIFUGAL PUMP.—R. N. TRANE, La Crosse, Wis. The invention has for an object the provision of a construction wherein the water is acted on at two stages before it is discharged from the pump. Another object is to provide a construction wherein the impeller of the pump will act on the water or other liquid in the proper manner when same is at a low speed, and will later act on the same water when at high speed for increasing in a regular manner the speed.

EXPRESSION MECHANISM FOR MECHANICAL PIANOS.—C. CONTAL and E. REQUILLART, 39 Rue Lemours, Paris, France. An object of the invention is to provide expression producing mechanism so fitted as to allow a performer to regulate at will the intensity of the different notes which may be played simultaneously both in the treble and bass so that he may at any moment decrease or increase the sound of either a single note or a group of single notes comprised in a given interval or notes distributed on the whole length of the keyboard.

TOMATO AND FRUIT SORTER AND DISTRIBUTER.—T. J. PETERS, Peters, Fla. The object of this invention is to provide means which will convey tomatoes and fruit without injury to a sorter where they will be turned over as they are conveyed to a sizer to assist in the removal of off-grade and ripe fruit; the size of which is adjustable, serving to separate the tomatoes and fruit according to size as they move to a distributer which directs the tomatoes and fruit to the packers.

FEEDING DEVICE FOR PRODUCING SPIRAL STITCHES.—H. ADLER, c/o A. & T. Mach. Co., 36 E. 4th St., New York, N. Y. The invention has for its object to provide a simple means for automatically moving a work holder transversely as it is advanced by a sewing machine feeder through the sewing process. Another object is to provide means for quickly adjusting the work holder transversely relative to the sewing machine needle, and for actuating the stopping means for the machine when the member moves transversely a predetermined distance.

CUTTER CLEARANCE GAGE.—W. DALLAS, 1120 So. 52nd St., Philadelphia, Pa. The invention relates to a precision measurement gage for indicating the proper clearance angle to be ground upon the cutting tooth of a milling cutter tool. An object is to provide a simple form of cutter clearance gage which may be applied to the tooth of the milling cutter for testing the ground angle of the tooth without removing the cutter from the mandrel of a grinding machine.

FRUIT GRADER.—E. S. LATNER, Acme, Mich. The invention relates more particularly to a machine for grading apples into given sizes. The general object is to provide a machine to facilitate the process of packing apples according to size and to provide a simple structure that will handle the fruit without bruising. The object is attained by use of a grading frame over which the fruit may roll, the frame being mounted to be oscillated and arranged for manual operation.

ROAD MACHINE.—J. H. MCLEOD, 1252 Fillmore St., Topeka, Kan. This invention has for its object to provide a machine which will work the road whether wet or dry, crushing lumps when dry and squeezing the water out of the ruts and packing the soil from the high places to the low places when wet, and afterward finishing and smoothing the road, wherein the crushing and packing is brought about by a roller having spiral ribs which work the soil as it moves thereover.

SAVINGS CLOCK.—A. G. P. WINGAARD, No. 3 Norrevold, Copenhagen, Denmark. This invention relates to a clock connected with a savings box, and arranged in such manner that the clock stops after the expiration of a fixed time, unless a coin is introduced into the coin chute. To remind the owner that time for inserting another coin has come, means is provided so that the dial, some time before the clock stops, is hidden with an inscribed cover notifying the owner to that effect.

(*Continued on page 136*)

# Lower Cost of Machining and Assembling Results From Change to Machine Made Castings

*FIG. 1. In drawing the pattern by hand the least quiver plays havoc.*

THE fundamental weakness in the making of moulds by hand is a normal human weakness.

Immediately upon completing heavy physical labor, the moulder must attempt operations which require 100% muscular control. Drawing the pattern by hand (Fig. 1) and patching the mould by hand demand a degree of delicate muscular accuracy properly comparable to the requirements of an etcher or a sculptor. Even the most skillful handwork at this stage varies sufficiently to leave a long trail of later expense in added cost for laying out, removing extra stock and often the scrapping of castings half-machined.

*FIG. 2. This actual chart-reading in contrast to Fig. 1 shows the absolutely controlled accuracy of a moulding machine in operation.*

Contrast the familiar inaccuracies of hand-moulds with the graph (Fig. 2) of the operation of a power-operated moulding machine. Although foundries, in general, may give to the casual observer an appearance of rough-and-tumble freedom, nevertheless because it is a basic process, crude, faulty foundry work is bitterly expensive later. Hence this test is employed by careful manufacturers of moulding machines, because accuracy equal to that of a Corliss engine or any fine machine-tool is an essential necessity.

The modern moulding machine is not only built to the uniformity of action shown by the graph but it is constructed to maintain throughout its life an accuracy within .0005 inch variation per inch of pattern draw. This it maintains in spite of showers of sand and dirt and a pounding of 6500 blows per day which are required to pack the sand.

In practice, what is the result of this accuracy?

The result is well illustrated in Fig. 4 which shows unretouched photographs of the same casting as produced by skilled hand work and as made from machine-

*FIG. 3. A moulding machine in action—2/3 of the machine lies below the foundry floor. The machine, by jolting, first rams the sand around the pattern. Then flask, sand and pattern are "rolled over" until the pattern can be raised mechanically by vertical draw from the sand.*

made moulds. Even to the eye the hand-made casting at the left is clearly not true to shape. Necessarily uneven hand-ramming has allowed the sand to bulge in spots under gas-pressure and the resulting hills and hollows have not disappeared in the casting in spite of painstaking slicking and patching of the mould.

On the other hand, for the machine-made casting at the right, the sand was rammed to uniform density throughout and the pattern, when withdrawn by mechanical means, came away clean, requiring no slicking to smooth the surface of the mould and destroy the even porosity of sand. This casting can be exactly reproduced hour after hour, day after day, without any variation great enough to be detected by the camera.

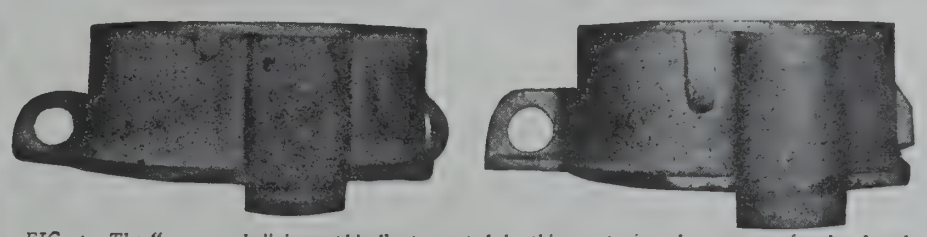


*FIG. 4. The "reason why" is graphically presented in this comparison by camera of a hand-made casting on the left and a machine-made casting on the right.*

Fig. 5 shows the second result of machine-moulding. An average of comparative costs furnished by scores of machine-shops which had previously operated on hand-made castings shows this surprising difference before and after the adoption of machine-made castings. This saving is reported as due primarily to four factors—

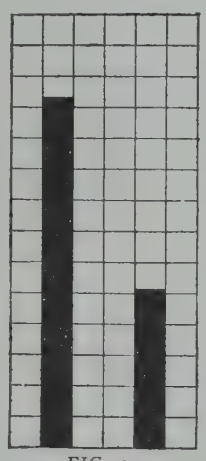


*FIG. 5*

1. Less layout work before machining because each machine-made casting is exactly like each other casting from the same pattern.
2. Less stock to be cut away on machines because of closer limits maintainable under machine-moulding.
3. Fewer castings found defective after receiving partial machining.
4. More adequate and regular supply of castings from foundry.

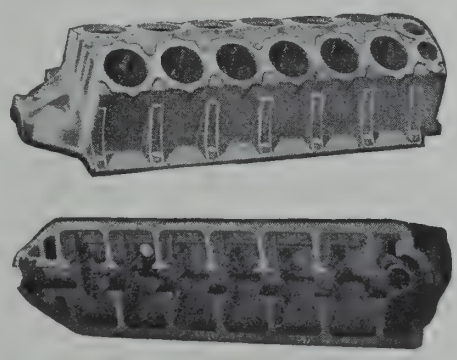


*FIG. 6. Quantity production of Liberty Motors would have been close to impossible if machine moulding had not produced thousands of uniform castings of this quality.*

In machine-shop practice certain very striking achievements have been made possible largely by the superior production-qualities of machine-made castings.

In our automotive industries lacking the advantage of foreign low-priced machine operators, rapid expansion would have probably been impossible had not the machine-made casting permitted standardization of machining operations and hence, wholesale economies. Without these economies few families could yet afford the initial cost of a car.

Shops which, during the war, operated on hand-made castings for the 12-cylinder liberty engine, and later on machine-made castings, can furnish some striking testimony as to the increased speed in handling the latter through machining and assembling.

It is largely true that in all plants where large scale production is produced by the

*FIG. 7. A 6-cylinder en bloc automobile engine casting is practically impossible except by machine-casting.*

aid of standardized operations, the machine-made casting is specified throughout. Here and there, however, still remain a few first-rank concerns which have not yet recognized the savings thus attainable and are puzzled by the fact that smaller competitors hold their own with them in cost of production. The advantage can usually be traced to the machine-made casting in the smaller plant.

The factory superintendent who has assumed that the modern moulding-machine is of interest solely to the foundryman as a means of increasing output and reducing costs will discover on even the briefest personal investigation that the subject holds for him the opportunity for equal or even greater savings. To neglect to investigate the machine-made casting is to make his competitor's path easier.

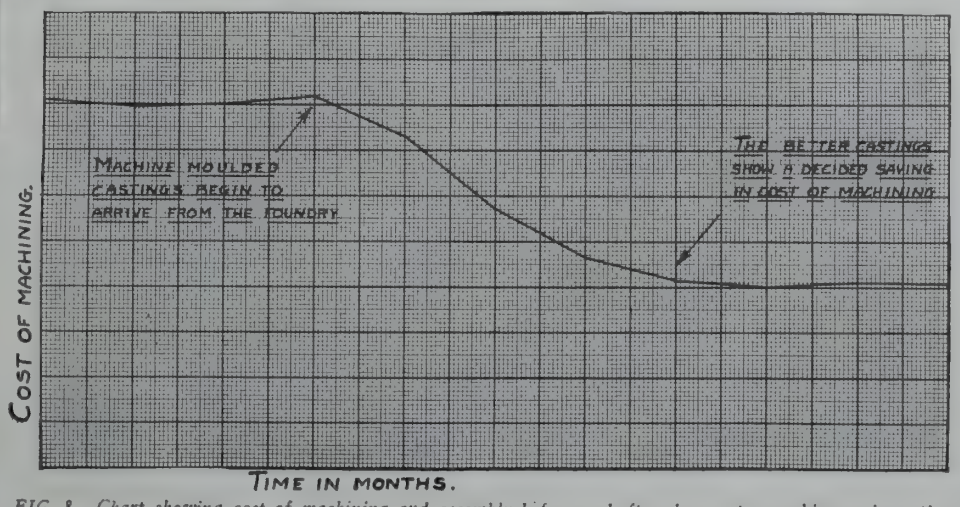
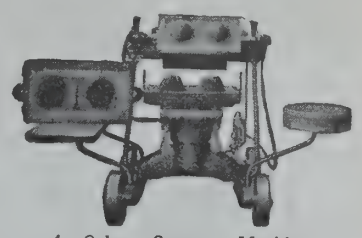



*FIG. 8. Chart showing cost of machining and assembly before and after change to machine-made castings.*

OSBORN

MOULDING MACHINES

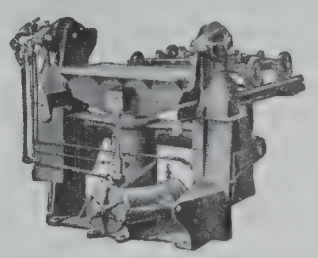
SOME picture of the world-wide acceptance of the machine-moulding process is indicated by the fact that the sales of Osborn Machines alone are today four times as great as the es-



*An Osborn Squeezer Machine*

timated total sales of all machines in the period preceding the World-War.

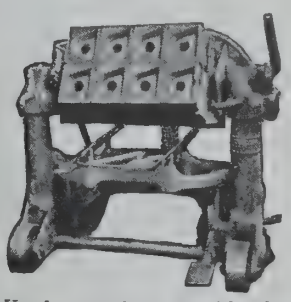
The functions of a moulding machine are three:—1. Ramming the sand by squeezing or jolting; 2. Rolling the mould over; 3. With-



*An Osborn Roll-Over Model*

drawing the pattern mechanically from the sand without damage to either sand or casting.

In Osborn practice these operations are performed either by hand-power or by air-power. The greatest saving in labor is obviously



*Hand-operated Osborn Moulding Machine*

secured by the latter but the saving in accuracy is attained by either method.

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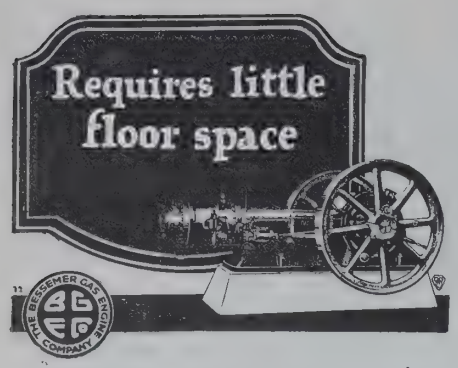


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The Crescent joint hugs the pulley. The belt runs the same as endless on pulley side.
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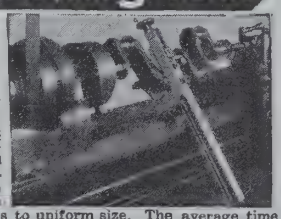

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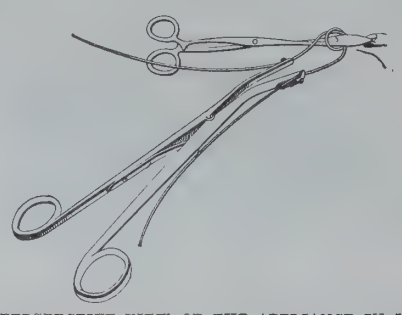
## RECENTLY PATENTED INVENTIONS

(*Continued from page 134*)

### Medical Devices

SURGICAL APPLIANCE.—L. O. ROBERTS, 146½ Kellingsworth Ave., Portland, Ore. The invention has for its object to provide an appliance of the character specified especially adapted for tying knots in ligatures in cavities



A PERSPECTIVE VIEW OF THE APPLIANCE IN USE

where it is difficult or impossible to reach with the hands. The device may be used in any cavity where it is difficult to insert the hands. In tying the knots the hermostatic forceps will be held by an assistant.

REMOVABLE BRIDGE FOR DENTAL WORK.—A. S. STONE, 133 Hegeman Ave., Brooklyn, N. Y. The invention relates to dentistry. An object is to provide a means for restoring teeth within a person's mouth and to provide a form of removable bridge work which may be fitted to sound teeth of a patient's mouth and support an artificial tooth so as to adequately fill a space left by the loss of a natural tooth, and may be removed for the purpose of cleansing the artificial members.

DENTAL APPLIANCE.—D. W. BARROW, 1216 Jas Bldg., Chattanooga, Tenn. This invention has for its object to provide an appliance intended to replace the wax bite used by dentists in obtaining occlusion for artificial teeth, which will permit true occlusion to be obtained, taking account both of the direct movement of the jaws toward each other and of the gliding movement of the lower jaw with respect to the upper.

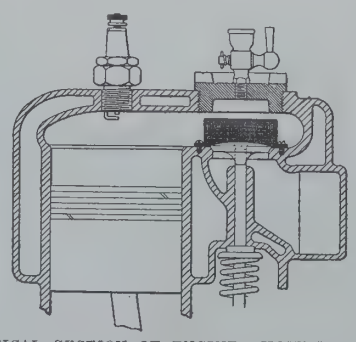
### Musical Devices

PLAYER PIANO CONTROL APPARATUS.—M. S. HOWARD, Interstate Power Co., Waukon, Iowa. The object of the invention is to provide for the employment of governors for controlling the degree of vacuum attained in the pneumatics. A further object is to provide a method of regulating the action of these governors, and to provide a method of applying the system of control to the action of the striking pneumatics of a player piano.

BANJO.—R. T. CARLUCCI, 87 Ferry St., Jersey City, N. J. The invention relates to banjos, mandolins, guitars, ukuleles, drums and similar instruments having a membrane. The object is to provide means whereby the owner of such instruments is enabled to readily detach a cracked, split or otherwise injured membrane and its mounting and forward the same to a manufacturer for replacing such membrane by a new one, and when received by the owner to allow the latter to reassemble the parts without the aind of a skilled instrument maker.

### Prime Movers and Their Accessories

CARBURETING SCREEN FOR INTAKE VALVES.—F. W. LAPHAM, 5036 W. 22nd Place, Cicero, Ill. This invention relates to screens for intake valves of internal combustion engines. An object is to provide a hood and means for clamping the same in place over the intake valve of an internal combustion engine, the hood being made of wire mesh, the



VERTICAL SECTION OF ENGINE SHOWING INVENTION APPLIED

structure being such that it will become heated during the use of the engine and will thereby distribute the heat to the incoming fuel so as to gasify the fuel even though the same may be of the more or less heavier kind as, for instance, kerosene.

VALVE GRINDER.—W. L. DINSMOOR, 925 Geary St., San Francisco, Cal. This invention relates particularly to valve grinders adapted for grinding valves of internal combustion engines. An object is to provide a grinding tool having means to engage the valve and vibrate the same back and forth on its seat for effective grinding and adapted also to be given a movement to optionally shift the valve to vary its position on its seat during the grinding operation, the shifting of the valve on its seat being necessary for true grinding.

### Railways and Their Accessories

AUTOMATIC TRAIN STOP.—F. J. MCAVOY, 496 Clinton Ave., Newark, N. J. This invention has particular reference to means for automatically controlling the running of trains in connection with the usual Westinghouse air-brake equipment. Among the objects is to provide obstacle mechanism associated with one of the rails of the track and including a vertically movable plunger adapted normally, when the track is clear, to be substantially flush with the rail over which the wheels pass, but when the block is occupied, or the signal mechanism set at danger, will project upwardly above the surface of the rail subject to being depressed by each wheel rolling on the rail.

LOCOMOTIVE CRANE SANDER.—T. H. COCHRANE, 168 Wilkinson St., Jersey City, N. J. An object of the invention is to provide a track sander device which is readily attachable to a locomotive crane of present day use. It is a purpose to provide a design of sanding device which will adequately funciton on a locomotive crane to the same effect and for the same purpose as the sanding device now applied to ordinary locomotives.

GRAIN DOOR.—N. SMITHBACK and W. H. MEIER, 17 W. Main St., Madison, Wis. The invention relates to grain doors generally and more particularly to grain doors which swing horizontally and are adapted especially for use with grain cars or the like. An object is to provide a door of this type which is leak-tight in closed position, with an outwardly swinging section and inwardly swinging sections, the inwardly swinging sections being positively prevented from swinging outwardly beyond the closed position of the door.

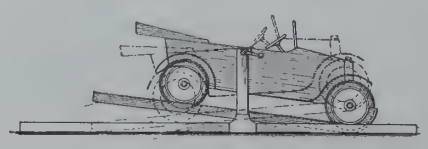
CONCRETE RAIL AND TRACK.—W. J. PLATTEN, 218 Oakland Ave., Green Bay, Wis. An object of the invention is to provide a concrete track which is stronger, more permanent and cheaper to maintain than the ordinary steel rail and wooden tie track in common use. A further object is to provide a rail and track construction which will prevent the usual sagging of the rail, in which an economy is effected in the use of steel, and in which the rail is held to the base by means of clamps which are adjustable, and which lock the rail in position, positively held from spreading apart.

### Pertaining to Recreation

AMUSEMENT APPARATUS. — E. S. DOUGHTY, 417 4th St., Red Wing, Minn. The invention relates to a trackway comprising a pair of side plates and a series of treads connected with the side plates, means for supporting the trackway in elevated position, which may be varied to suit conditions, mechanism for permitting the trackway to be set up where desired, and taken down and folded for permitting of storage or transportation.

### Pertaining to Vehicles

AUTOMOBILE JACK.—W. H. BUTTERS, 715 Center St., Calgary, Alberta, Canada. The object of this invention is to provide a jack on to which an automobile can be easily run and



A SIDE ELEVATION OF THE DEVICE

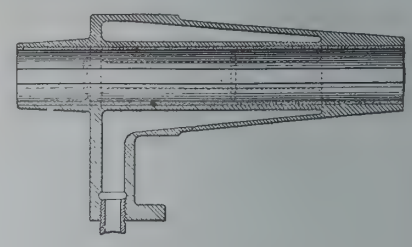
can be elevated or tilted to any desired angle and held in this position as long as desired. A further object is to provide a construction of carrier and means for operating the same to elevate and lower the automobile.

AXLE RECONSTRUCTION.—J. R. FLEMING, 801 Monroe Ave., Scranton, Pa. Among the principal objects which the invention has in view are, to avoid waste of partially worn axles, to renew service conditions in journals for wheels and similar members, to avoid loss of time in repair on car construction, and to add to the construction without weakening the part added to.

CART.—J. HINTZ, 2726 N. Lawndale Ave., Chicago, Ill. An object of the invention is to provide a small cart or wagon which has a rocking chair seat, and which may be propelled by the occupant of the chair in rocking back and forth. A further object is to provide a novel form of cart or car which is simple in construction and relatively cheap to manufacture.

VALVE.—G. W. THOMPSON, Cheboygan, Mich. This invention has for its object to provide a valve adapted to be interposed in the fuel supply line of a motor vehicle, and in the oil line for controlling the flow of the fuel to the carburetor and having means normally operative to cut off the fuel supply, but controlled to inoperative position by the flow of oil through the valve, the arrangement being such that when the oil does not flow the motor will be stopped.

VULCANIZER.—E. D. HOSTLER, c/o Haiiiel & Mather, Tipton, Iowa. More particularly this invention relates to a mandrel for use in vulcanizing the ends of the inner tubes of automobile tires and the like, an object being to provide a device which permits the tube



A LONGITUDINAL SECTION OF OUTER SURFACES OF THE MANDREL

ends to be vulcanized on the outside thereof, thus permitting a ready manipulation of the tube so as to insure a proper positioning of the parts and also permit of full observation of the vulcanizing process.

NON-SKID FOR WHEELS.—F. HUDA, 469 Division St., Perth Amboy, N. J. The invention has particular reference to means for applying short chains to wheel tires. Among the objects is to provide a simple device for attaching a chain to a wheel felly especially a wooden felly, the chain being adapted to pass transversely over the outside of the tire from one side of the felly to the other, means being provided for the most convenient attachment, and positive holding to the sides of the felly as distinguished from the inner surface thereof.

APPARATUS FOR UTILIZING THE TREPIDATIONS OF VEHICLES.—M. A. CANALE and R. FRIAS, Calle Maiper, 671, Buenos Aires, Argentina. This invention relates to an apparatus for the purpose of utilizing the trepidations and shaking movements originated by the varying of level in any kind of vehicle, transforming them into a rotary motion of sufficient intensity so as to be able to set in motion any kind of apparatus which requires slow speed to work.

### Designs

DESIGN FOR A PURSE.—C. A. NICHTHAUSER, 32 Union Sq., New York, N. Y. The inventor has been granted patent on two designs of a similar nature.

DESIGN FOR A RUBBER HEEL PAD FOR BOOTS AND SHOES.—J. E. BARNEY, address Pioneer Products Inc., 30 E. 42nd St., New York, N. Y. The invention has been granted three patents of a similar nature.

DESIGN FOR A TOOTHBRUSH CASING.—E. H. WIERSCHING and E. K. WIERSCHING, 249 Main St., Susquehanna, Pa.

DESIGN FOR A POWDER CONTAINER.—C. S. HUMPHREY, c/o Manhattan Can Co., Bush Terminal No. 10, Brooklyn, N. Y.

DESIGN FOR A SANITARY FOUNTAIN.—T. LLOYD, 1 Taylor St., Boston, Mass.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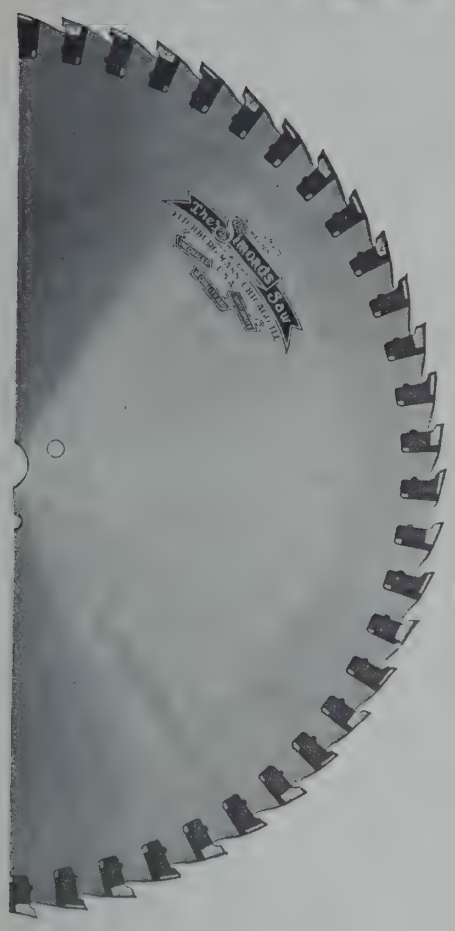


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## In the Wake of the Woodsman

*(Continued from page 122*

abundantly. Experiments with eroded soil prove that much of the soluble salts are washed out. The Department of Agriculture found that in all the constituents excepting potash non-eroded soil was much richer. The greatest difference was in nitrogen, one of the most important of plant foods. This is because a large proportion of the nitrogen compounds are readily soluble in water and were carried off. Not only was the fertility of the soil destroyed but its water-holding capacity was reduced from 67.2 per cent to 46.8 per cent. More water was required to produce a very inferior plant growth on the eroded soil.

Only the very hardiest, and usually the most useless, of plants can gain a foothold on eroded ground and it may be decades after the plants gain a stand before the ground will have sufficiently recovered its fertility through decay of vegetation to support the plants which formerly grew on it abundantly.

When water has finished its destructiveness on barren land, the wind has its innings. Where the eroded area is of wide extent, the wind, unhindered by trees or vegetation, continues in dry weather what the rain has begun, and often six or eight inches of soil will be removed in spots by a single windstorm.

But not only is harm done to the soil. The amount of moisture evaporated into rain clouds is much less where there is no vegetation and a drier climate results. Windstorms are unobstructed and more frequent. This may account, in a measure, for the increasing number of destructive tornadoes in the Middle West in recent years.

One of the principle causes of erosion in the Middle West is over-grazing of cut-off forest lands. Grazing within reasonable limits is not harmful but where sufficient cattle are turned on the land to crop the vegetation close and pack the soil, the future usefulness of the soil is almost sure to be destroyed. A single big rainstorm, under such conditions, may carry away the accumulated vegetable decay of ten years. Once erosion sets in the destruction is sure and rapid, and any known process of rebuilding the soil is slow and uncertain.

The conclusion is obvious; our remedy must be prevention. If care is taken to see that a good stand of seedling trees is left in cut-over forest areas, these only need protection from fire to insure a second crop of timber. Our Forest Service has done wonders with the meager funds as its disposal, but the funds are entirely inadequate. It is estimated that an adequate forest policy would be self-supporting within a very few years. But even if it were a constant expense our lawmakers should be willing to undertake it to insure against a repetition of China's case.

But the problem must be solved not only in the care of our national forests, but in the preservation of our farm woodlands. The farmers own as large an area of woodland as the lumbermen and all others combined. Much of the hardwood supply of the country comes from this source.

The farmer uses most of the product of these lands himself, either as cord wood or for other farm purposes. He usually regards his woodlot as a sort of reserve and when he is in need of ready cash, he cuts off the trees and sells them. As a result few farm woodlands are fully stocked with trees and fewer still have trees which yield the best crop. A campaign of education needs to be undertaken, but such campaigns are expensive and there are no funds available. In this connection it ought to be remembered that not only is the problem one of forests; every single tree whether it be in a city street or a country field plays its part in the regulation of winds, climate


# They Chose St. Louis

THIS $5,000,000 plant of the General Motors Company is one of almost 100 new plants, and a total of 15,000,000 feet of floor space, built in St. Louis in the last two years. In one industrial district alone new industries have been established costing more than $20,000,000 and employing 14,000 workers. The new factories built 8,000,000 feet of floor space, and the already established St. Louis industries expanded 7,000,000 feet.

Why were these big plants built in St. Louis? This general movement to the one point was not an aimless change of location, but was the result of a businesslike investigation of production and distribution advantages.

These industries spent millions of dollars in locating at St. Louis so as to be near the center of economic distribution, near the center of raw materials, and within easy reach of the markets in every direction. Twenty-six railroads and the Mississippi River carry their goods to all markets.

The business men of St. Louis are awake to the advantages of the city, and are seeking sixteen specific industries to manufacture goods for which there is a need and a profitable market in the St. Louis trade territory. These industries are:

*Shoe laces and findings*
*Cotton spinning and textile mills*
*Dye stuffs*
*Steel and copper wire*
*Machine tools and tool machinery*
*Automobile accessories and parts*
*Drop forge plants*
*Tanneries and leather products*
*Malleable iron castings*
*Farm implements*
*Rubber products*
*Screw machine products*
*Locomotive works*
*Blast furnaces*
*Cork products*
*Small hardware*

The booklet "St. Louis as a Manufacturing Center" gives details that will be interesting to you. A letter will bring it if addressed to

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**St. Louis Chamber of Commerce**

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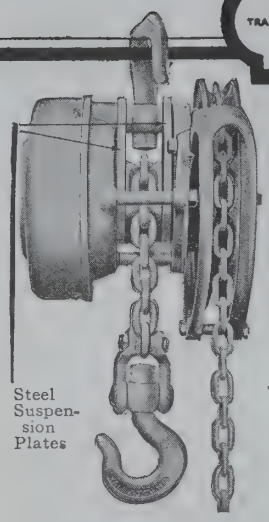
YALE TRADE MARK



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The above illustration shows a number of Williams' "C" Clamps. "Vulcan" heavy service, "Agrippa" medium service, "Light Service" and "Vulcan Tool Makers' Clamps" carried in stock in all sizes. Booklet with detailed description will be sent on request.

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and rainfall. The American Legion has been highly commended by forest experts for its policy of planting trees as memorials to fallen heroes.

The observation of Arbor Day by school children has resulted in the planting of thousands more of trees which will be preserved largely because of their sentimental value.

There is hardly a man but who at some time or other has to make a decision as to whether a tree shall stand or fall. It is the part of patriotism whenever possible to let it stand.

### The Last Word in Searchlights

(*Continued from page 123*)

degrees. It has a grid of five coils mounted in a single plane. Of course, to operate these lamps on land, transformers or resistances are required, depending upon whether the circuit is alternating current or direct current. The 32-volt lamp will operate with no appurtenances on the average boat circuit, which is usually of 32-volts pressure. The globes for all these lamps are of hard glass, lead glass being too soft to withstand the tremendous heat generated.

Beginning this year, sane Fourths of July can take on new glory with the brilliant aid of these incandescent searchlights. Spectacular color effects and beautiful ground and aerial displays have been worked out by engineers for scores of great outdoor night pyrotechnics such as those at the Panama-Pacific Exposition, the Hudson-Fulton celebration and other illuminations nationally famous. Many of these have adaptations which could be used and doubtless will be used in "fireless fireworks" shows of the future based on incandescent searchlights which cost less, operate more economically and are far more adaptable to varying conditions than are searchlights of medium size.

### Guiding Ships by Electric Cables

(*Continued from page 123*)

been put in operation at Portsmouth, one to indicate the entrance channel and the other for the exit channel. The entrance cable starts from a powerful electric station provided with a wireless outfit and runs to a point 1,454 meters to the south, 4 degrees west of Horse Sand Fort, this first part being laid upon a very shallow bottom is not intended to be employed as a guide. The cable then follows the passage southward 63 degrees east for a distance of 10 kilometers, after which it runs 13 kilometers to the south, 1 degree west and 2 kilometers to the south, 6 degrees east. At this point the end of the cable has reached the latitude 53°, 33′, 36″ north, and a longitude of 0°, 56′, 42″ west at a depth of 27 meters. The entire course covers 30 kilometers.

By interrupting the current at given intervals corresponding to dots and dashes of the Morse telegraph code, ships provided with suitable galvanometers or indicators are able to recognize their position as regards the cable at distances of from 400 to 500 meters.

The signal transmitted is the letter V or the letter X, and certain devices enable the ships to signal how far they are from the terminus. Ships which desire to make use of this guide cable, either for maneuvers or to make port, must notify the Block House Fort at least half an hour in advance and must state the time during which they expect to use the cable. Ocean ships communicate by wireless with the Culver Cliff Station which relays the message to the Block House Fort, and the latter acknowledges the receipt of it and advises the ship of the time when the alternating currents are sent. The cable is marked 2946 and 2650 on the Admiralty charts. The matter has already attracted interested attention in France, and will doubtless do so in this country. It seems highly probable, too, that the Marine Insurance companies will vigorously push the plan of having ports difficult of access thus safeguarded, since the initial expense is small compared with the loss of even a few boats.

### Who Invented It First?

(*Continued from page 124*)

and received a patent on this same style of clip. Mason immediately filed an application for patent for the same thing, claiming that he was entitled to the patent because he had invented it seven years before and produced the clip and the witnesses to prove that such was the case. The court admitted that he had completed the invention as claimed, but refused to grant him the patent because he had not disclosed his invention to the public, but had concealed and suppressed it. They quoted with approval from a case decided by the Supreme Court of the United States many years ago:

"The inventor, who, designedly and with a view of applying it indefinitely and exclusively for his own profit, withholds his invention from the public, comes not within the policy or objects of the patent system. He does not promote, and if aided in his design would impede, the progress of science and the useful arts; and with a very bad grace could he apply for favor or protection of that society which, if he had not injured, he certainly neither benefited nor intended to benefit. Hence, if during such a concealment an invention similar to or identical with his own should be made and patented or brought into use without a patent the latter could not be inhibited nor restricted upon proof of its identity with a machine previously invented and withheld and concealed by the inventor from the public."

While the great part of the conflicts as to the right to a patent arises between independent inventors, there are cases where the rival claimants do not know of each other's activities. In some of these cases it looks as though there were a deliberate attempt on the part of one party to appropriate the invention of another. Cases of this character are few and are decided according to the same rules as would be the attempt of another to appropriate your watch to his own use. A fact not to be lost sight of is that when anyone makes application for patent he makes oath to the fact that he verily believes himself to be the original and first inventor. False swearing is punishable here as in any other instance of false swearing. Cases which on the surface look like attempts at appropriation, when simmered down often show that such inventor really believes that he and not his rival was the real inventor.

There is another situation wherein the rival claimants for a patent are aware of each other's activities. It arises out of the employment of one individual by another as a result of which the invention is brought to a practicable form or state of perfection by the employee. This can be illustrated best by a decided case. A was the superintendent of a concern manufacturing iron bedsteads. He brought to the foundry of B's company, for the purpose of having a casting made of it, a wooden model of a device for connecting the rail and post of an iron bedstead. He was referred to B as the pattern maker. Some conversation ensued between A and B during which B pointed out some faults, as he considered them, in the model. A went away but returned in half an hour and in the interview then had between himself and B, the latter suggested the introduction of a headed rivet in the model. To this suggestion A acceded, and at the request of B subsequently brought to the latter a section of pipe such as is used in beds, with a headed rivet attached from which B made the model from which the castings were made which were subsequently used in a bedstead. A conceded that the feature of the headed rivet was B's suggestion, although the headed

LEGAL NOTICES

# PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

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contains Patent Office Notes. Decisions of interest to inventors—and particulars of recently patented inventions.

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rivet was only one element of the invention. The court decided that the invention including the headed rivet belonged to A. The law governing cases of this character was laid down by the Supreme Court as follows:

"Where a person has discovered an improved principle in a machine, manufacture or composition of matter and employs other persons to assist him in carrying out that principle and they in the course of experiments arising from that employment make valuable discoveries ancillary to the plan and preconceived design of the employer such suggested improvements are in general to be regarded as the property of the person who discovered the original improved principle, and may be embodied in his patent as part of his invention."

This rule of law as stated by the Supreme Court is a just one and is based on the general equitable principle that a person cannot be permitted to make capital out of a fiduciary relationship. If the employe had never been taken into the confidence of the employer and entrusted with the underlying principle of the invention obviously he could never have made his improvement. However, if the employe, after the ideas of the employer had been communicated to him devised an independent invention not dependent in principle upon the plan suggested to him by his employer, the employe is entitled to receive the patent therefor.

## Our Deep-Sea Freighters

*(Continued from page 126)*

facilitates the handling of either fuel oil or water ballast. The sixth compartment is for the storage of fresh water.

The propelling machinery consists of one Curtis General Electric marine turbine, with double reduction gear, and is capable of developing 3,000 shaft horsepower. When a 17-foot propeller is making 90 turns a minute a speed of 11 knots an hour is realized. The turbine is constructed to operate on steam at a pressure of 200 pounds, with 40 degrees superheat. The turbine rotors can be reversed instantly and are designed to maneuver at half speed—a special valve is provided which admits the steam to either the ahead or the astern rotor. This arrangement provides a desirable degree of operative flexibility. Steam is furnished on each of these boats by three single-ended Scotch marine boilers having a total heating surface of about 8,400 square feet. The boilers are equipped with a forced-draft system, and their oil fuel outfit is of the mechanical burner type. It is said that the double-reduction turbine drive has functioned successfully under severe sea-going conditions.

The ships have numerous winches, conveniently placed, which, with the several 5-ton derricks, are able to handle cargo in a thoroughly expeditious manner. It is a source of satisfaction to know that these freighters have shown themselves to be admirable in many ways and to represent a type which should become conspicuous in our fleet of trade. They are especially suited for the handling of bulk commodities by reason of their distinctive method of construction.

The Isherwood system is primarily designed to afford great longitudinal strength so as to resist the lengthwise stresses set up in a craft exposed to the open seaway. Likewise, the form of structure adopted in this system is intended to promote transverse rigidity so as to offset forces likely to induce diagonal distortion. The ordinary ship is of the so-called transverse-framed type, and lacks in some respects the stiffness which is obtained by the deep frames installed at suitable intervals in craft of the Isherwood pattern. These frames are in effect continuous athwartships because they extend under each deck and rise to the upper limits of the hull.

Analyses of ships of identical dead-

# Five Weeks of Salt Water!

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has a thick, heavy covering *woven* like a piece of fire hose, that withstands oil, gasoline and hard usage just as it shed salt water. It increases efficiency and keeps down costs. It will add to the value of any electrical tool, machine or hand lamp equipped with it.

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*This is Duracord. Thick, heavy strands, woven like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.*

*Here is the ordinary braided cable covering. Note the open and porous construction easily cut, stretched or unraveled. Compare it with the illustration of Duracord.*

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weight cargo capacity but dissimilar so far as the substitution of the Isherwood system is concerned, go to show that the latter method permits of a material saving in weight of steel while insuring a somewhat sturdier structure. It is claimed for the Isherwood-built craft that she is easier to clean and to paint inside—thus promoting better upkeep and lessening the likelihood of unsuspected deterioration. Finally, because of the larger measure of free space in the holds, the advocates of the type say that the Isherwood vessel can carry two per cent more cargo. To put it popularly, we are told that thirteen cargo carriers built on the Isherwood system requires only the same weight of steel as that needed to produce twelve ships of ordinary construction of the same dimensions!

While the Isherwood craft does call for more small fitting work than the transversely-framed boat, still this is discounted by a smaller amount of heating and bending of shapes. In putting an Isherwood steamer together, the erecting can be carried out with greater ease and economy than is commonly the case with the older and generally prevailing practice. And then during the building period the Isherwood ship can be assembled deck by deck—floor by floor as we would say in house building—and this reduces, accordingly, the heights to which materials must be raised while the hull is growing. In the transverse-framed vessel, on the other hand, the frames are erected at the very start to their full height, and everything going aboard for any stage of the work must be lifted up and over the tops of these frames to reach a point within them.

There was a time when we gave little heed to items of this sort, but it must be plain to the thinking person that it takes longer, requires a bigger expenditure of power, and costs just so much more to lift or move any weight a foot in excess of actual requirements. Considering, then, the thousands of pieces of metal and equipment that are brought into place while a ship is still on the blocks, it should be manifest that the Isherwood system reveals how substantial economies can be effected at the very start.

## The America's Cup Races

(*Continued from page 128*)

at any port in which she might find herself for the time being.

The final and decisive race, held July 27th, was won by "Resolute" in a light and variable breeze. "Shamrock IV" led across the line, and Mr. Burton had "Resolute" under her lee. And then followed one of the greatest surprises of these contests; for in the light air of 3 to 5 knots, "Shamrock" succeeded in holding the weather position for over two hours. The start was made at 2h. 17m. and it was not until 4h. and 23m. that "Resolute" succeeded in crossing the challenger's bow. Once clear of "Shamrock," "Resolute' began to draw ahead, and turned the outer mark at 5h. 18m. 35s. "Shamrock following at 5h. 22m. 42s. The "Resolute" gained some 9 minutes on the last leg and finished with an actual lead of 13m. .05s, and a total lead, including time allowance of 19m. 45s.

Thus was concluded the most closely contested series of races ever held on the Sandy Hook course. Sir Thomas Lipton, with the first two races to his credit, came nearer to winning the cup than any of his predecessors. Only once in the past sixty-nine years has the challenger taken a race. That happened in 1871, when the defending yacht, "Columbia," was disabled, and the race went to "Livonia."

Sir Thomas does not take back the Cup, but he does carry with him the warm regards of the American people, and their high appreciation of a sportsmanship which accepts defeat after defeat with a smile and with words of congratulation to the victor.

## The Romance of Tungsten

(*Continued from page 130*)

tungsten was found useful in certain steel alloys. Mixed with an adhesive it was made into lamp filaments that were efficient but exceedingly fragile. However, no metallurgist was able to discover a way to work tungsten separately. This was because in pure metallic form it is absolutely brittle. It confounded all experts with its utter intractability. The established processes in working other metals proved useless with tungsten.

Perhaps it was this very thing which finally brought about the harnessing of this valuable metal. Because it had so steadfastly refused for more than 100 years to respond to the arts of the metallurgist, Dr. Coolidge, with the instinct of the true scientist pioneering in untrodden fields, tried ways that any metallurgist would have thought an idle waste of time. The result was that after long effort and many failures he finally made tungsten ductile and workable so that it could even be drawn like wire down almost to the gossamer fineness of spider's web and still be strong enough to permit its winding and curling into almost any shape. When he had done that he had conquered tungsten and made possible many devices which could never have been built without ductile tungsten.

The radical difference in workability between tungsten and normally ductile metals, the difference which nonplussed the scientific world for more than a century, may be explained thus:

Pure tungsten pressed into bars is brittle after the very treatment which makes other metals most ductile. It differs from all other ductile metals in that when composed of grains it is extremely brittle at "room temperature," but is ductile at this temperature when fibrous.

Many an experimenter had sought to work tungsten mechanically, but none had ever succeeded in getting this intractable metal into a form suitable for mechanical working. Moissan, by an electric furnace method, obtained tungsten in a porous condition which could be slightly compressed and the pores closed up by hammering when hot. However, nobody in the world suspected at that time that if tungsten could be obtained and put into suitable condition and then mechanically worked at suitable temperature, its inherently brittle nature would gradually disappear. But nobody knew how even to make a start upon the problem of working tungsten.

To make any ordinary metal soft it is heated above its annealing point and then cooled down to room temperature. Doing this to tungsten, however, left it as brittle as ever.

Violating all metallurgical rules and working for years with utmost patience, Coolidge discovered the astonishing fact that the only way to make tungsten ductile was to mash tungsten's grains out into fibrosity and thus make the metal ductile cold and this he did by first heating it to a degree below its annealing point and then mechanically working it with infinite pains at a variety of heats each cooler than the one before until the metal got down to room temperature. A similar treatment, if applied to ordinary metals would destroy their ductility.

He worked out a process which, if followed without the slightest deviation, stretched the grains out, thus attaining ductility. But if the working varied from his process, failure resulted. The tungsten would smash to flinders at a stroke when it got cold.

This elaborate and delicately measured system of working tungsten is a scientific triumph.

Thus was tungsten finally made ductile.

The greatest immediate use for it was in the making of electric lamp filaments. Previously the best filament was made of fine tungsten powder, mixed with a binder into plastic mass which was squirted

through fine dies to produce fragile "wire."

This was an enormous improvement over the old-style carbon filament, thanks to the fact that tungsten, with a melting point of 1,350 degree Centigrade, will stand more heat than other metals and its vapor tension is so low that even under tremendous heats its volatile decomposition is slow. Tungsten even in this form made so good a lamp that it saved the American public a billion dollars a year on its electric light bill.

But filaments of those days could not withstand the slightest jar during the process of manufacture. They necessarily could not be strongly mounted in lamps.

Pure tungsten on the other hand drawn into filaments can stand almost anything. For one thing it is one of the heaviest metals. Whereas wrought iron weighs 490 pounds per cubic foot, and lead 708 pounds, tungsten tips the beam at 1,193 pounds. Its tensile strength is startlingly high. After it has been worked down to drawn wire of about a thousandth of an inch diameter its tensile strength is no less than 600,000 pounds per square inch of cross section. This is greater than the best piano wire.

To produce tungsten from sheelite or wolframite the ore is fused with alkali carbonates and the fusion dissolved in water. This may be changed to tungstic oxide by adding acid. The oxide, a yellow precipitate. is then filtered off. The tungsten oxide is purified to any desired degree by dissolving it in ammonia and then precipitating by adding acid, followed by filtering and washing.

To use tungsten in lamp manufacture, it is dried, mixed with thorium nitrate solution and then thinned with water into a batter. This is dried and heated at 2,000 degrees Fahrenheit for an hour in a silica or fire clay crucible to agglomerate the fine particles into coarser ones. This mixture is reduced by hydrogen at 1,800 degrees Fahrenheit into tungsten metal powder.

The reduced tungsten powder is poured into a steel mold which is a slab whose face bears a groove a quarter of an inch wide and deep. Under hydraulic pressure of 16 tons per square inch this groove full of powder is pressed into an ingot 16 by ¼ by ¼ inches. The pressure has been exerted on the sides of this ingot, not the ends. The ingot at this stage is too fragile to handle.

The slug next goes into an electric furnace where it is baked at about 2,400 degrees Fahrenheit. Now it is strong enough to handle. It is then sintered in a hydrogen atmosphere, the bar being heated for 10 to 15 minutes to about 5,000 Fahrenheit by the passage of an electric current through it.

The bar though brittle when cold is ready to be worked. It is heated to about 2,800 degrees Fahrenheit, and passed through the revolving dies of a swaging hammer which reduce its size and produce it in rods growing smaller and smaller and necessarily longer and longer as the metal goes through one swaging after another until it gets down to a diameter of three hundredths of an inch. It is now a metal that is ductile and its strength has increased with leaps and bounds so that at a diameter of three hundredths of an inch it can stand a pull in the proportion of 215,000 pounds per square inch of its diameter.

But it is still too large for lamp filaments, though wound on drums it appears hardly coarser than linen thread. So it starts into the process of being drawn down by successive stages through diamond dies of smaller and smaller sizes to any degree of fineness needed. On the drawing machines it unwinds from the feeding spool, passes through a lubricant, runs through a small gas furnace to attain red heat, negotiates the infinitesimal "eye" in the fragment of diamond clamped in its course, and is wound on a receiving spool ready for use.

Various of these fine sizes of tungsten wire are used for lamps of wide range of powers, the finest of them all being used for the tiniest of lamps such as "bug-lights" on automobiles and in flash lights. The diameter of this is 0.004 of an inch. It is six times finer than human hair. The original pressed ingot 16 inches long would produce more than 250 miles of such wire.

Tungsten wire thus produced is what has made the incandescent lamp the thing of power and service it is today.

The metal is worked in various other ways for its various other uses, but it never could have been had not Dr. Coolidge spent years in experimenting with it beyond the point where the scientists and metallurgists of the world had written the word "impossible."

### Gas-Filled Tungsten Lamp Patent Sustained

IN a carefully considered opinion written by Judge Hough, the U. S. Circuit Court of Appeals in New York, sustained on June 2nd, the Langmuir patent No. 1,180,159 for the Gas-Filled Tungsten Lamp. This lamp is the invention of Dr. Irving Langmuir, the well-known scientist in the Research Laboratory of the General Electric Company, which owns the patent.

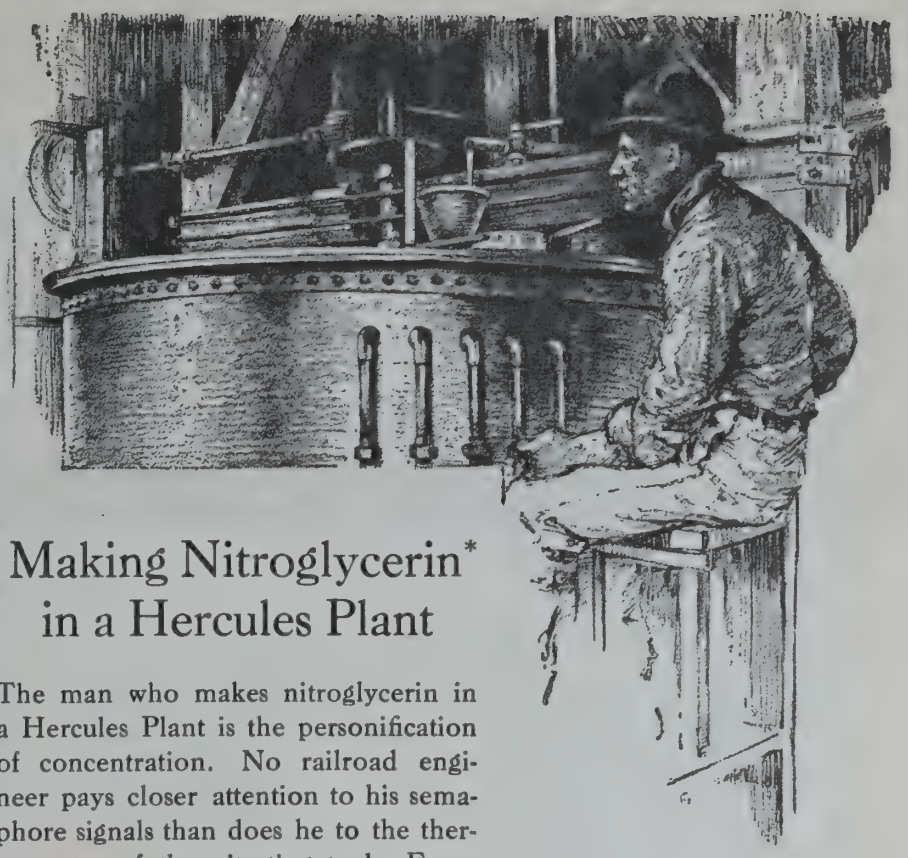
While several claims of the patent were in suit and sustained by the Court, the commercial nitro-tungsten lamp is well described in the following claim of the Langmuir patent, which is one of the claims held to be infringed by the defendant's lamp:

"An incandescent electric lamp having a filament of tungsten of large effective diameter and a bulb or globe therefor filled with dry nitrogen at a pressure as high or higher than that corresponding to 300 millimeters of mercury, the filament being thereby adapted for operation at a temperature higher than that which it would have if operated in a vacuum at an efficiency of one watt per candle."

The Court recognizes, as did the inventor, that a tungsten filament was not new with Langmuir, and that others, including Edison himself, had previously suggested the idea that a gas such as nitrogen might be introduced into a carbon filament incandescent lamp, but all such attempts to carry out that idea had been complete failures. Such suggestions the Court aptly characterizes as the history of "hopeful suggestion," and points to the fact that in 1913, when the Langmuir invention was made, so eminent an authority as Alexander Siemens regarded the vacuum tungsten lamp as the last word in glow-lamp lighting, without hope of any lamp improvement thereupon which might be of economic importance. The consequence of Edison's failure to find any utility in a gas-filled lamp was that lamp makers, the world over, remained convinced that the better the vacuum the better the lamp. Dr. Langmuir worked out his idea from the scientific standpoint, and the production of the gas-filled tungsten lamp was not only a scientific achievement but a revolutionary idea in practical lamp making.

After reviewing the technical theories advanced from time to time in regard to certain phenomena in incandescent lamps, the Court sums up its conclusions as follows:

"To us it seems fairly certain that both the commercial and the theoretic arts had been put on the wrong road by Mr. Edison through the disclosure of his patent No. 274,295 when in 1883 he proposed to fill a carbon filament bulb with an 'inert gas,' viz., nitrogen, at a pressure of about two-thirds of an atmosphere and stated as one of the means of his hoped for success that 'the filament before carbonization may be reduced to a *smaller* cross section than usual heretofore in order to produce reduction of radiating surface.' This was unquestionably wrong and we fail to find any suggestion in the evidence regarding the scientific discussion and theoretic statement that before Langmuir any scientist disclosed to the world that in the nitrogen filled bulb the loss by convection would be diminished and a working compromise reached between

## Making Nitroglycerin* in a Hercules Plant

The man who makes nitroglycerin in a Hercules Plant is the personification of concentration. No railroad engineer pays closer attention to his semaphore signals than does he to the thermometer of the nitrating tank. From the moment when he begins to feed glycerin into the acid in the tank until the operation is complete the thermometer is his guide.

It is important that the temperature of the mixture in the tank be kept uniform. If glycerin is added too rapidly the temperature rises, if too slowly it falls. So with eye on thermometer and hand on valve controlling the glycerin flow, the Hercules "N. G." maker follows the process minute by minute until its completion.

To just such watchful care as this is the uniform high quality of Hercules Explosives largely due. The men who work in the twelve Hercules plants realize the importance of the great tasks performed by Hercules explosives. As a result, wherever these explosives are used—in the building of railroads or highways, in the mining of metals and minerals, to increase the crops on a farm or dig the foundation for a city hotel—their giant power is never found lacking.

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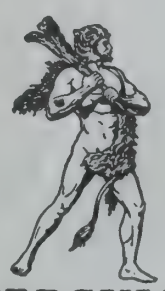
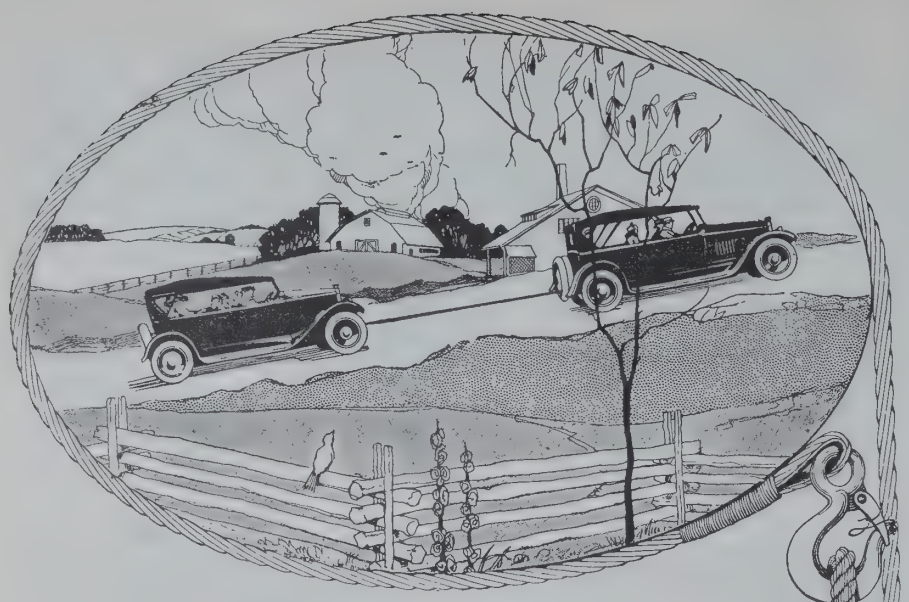
**Nitroglycerin is made by combining, in exactly the proper proportions, glycerin with a mixture of nitric and sulphuric acids. The combination takes place in a tank equipped with brine coils (for cooling purposes) and agitators which insure thorough agitation.*



**HERCULES POWDERS**



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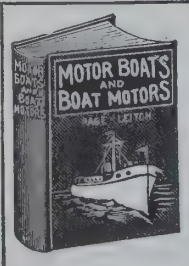


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that loss and the gain in filament life by increasing the 'effective size' of the filament itself.

"The patentee was also the first to establish another crucial and illuminating fact, viz., that with a tungsten filament, nitrogen of ordinary or commercial dryness was worse than useless. There is no evidence that any one before Langmuir had even suggested that in order to prevent a bulb-blackening fatal to the success of any lamp, the removal of water vapor not only from the gaseous filling but from the bulbs and filaments themselves must be carried to an extent theretofore unused, if not undreamed of.

"In short it was not through isolated experiments, but by correlating deductions from many of them, that the patentee produced in 1913 a lamp which, in the larger sizes, can operate on the usual 115-volt circuit with an efficiency as low as a half a watt per candle. . . . Not even the laboratory problem had been solved before this patentee did it; and we hold with the lower Court that invention was present."

While thus sustaining the patent on certain claims and against a specific construction found to infringe, the Court points out that the patent may possibly hereafter be construed to cover filaments other than tungsten and gaseous fillings not named in the specification of the patent.

### Right Foundation for Our Roads

THE United States Bureau of Public Roads and the Federal Highway Council are jointly conducting a national inquiry to obtain scientific information concerning the characteristics of road-building soils. The coöperation of thirteen highway district engineers has been obtained, 20 sample bags and tag envelopes having been supplied each engineer for shipping samples of highwav soil to Washington.

Road failures attributable to unstable foundations are possible of elimination by pursuing either of three alternatives: By having the road surface thick enough so that the pressure will be sufficiently distributed to the underlying subgrade or so that the surface due to inertia may absorb much of the shock of traffic; by designing the slab so as to insure adequate strength over the soft subgrade; or by improving the drainage systems to exclude the moisture in dangerous quantities from soils having very low bearing value due to the presence of water.

The nation-wide research as to the specific reasons for failures of highways involves the inspection of "break-downs" due to inferior subgrades, whether attributable to inadequate drainage or to peculiar soil conditions. Samples of one cubic foot each are taken from the subgrade, photographs made describing the failure, and exacting information furnished relating to topography, preferably in the form of cross-sections and profile of the road in the vicinity of the undermining influence. Notes are to be written describing the character of the failure, the approximate amount of traffic, drainage conditions, the presence of water-bearing strata or other influences that may be responsible for the wet condition of the subgrade.

An auger 1½ inches in diameter is suggested by the Bureau of Public Roads as a convenient instrument for exploring the underlying subgrade, useful information being obtainable by observing the texture and condition of moisture of the soil at varying depths. How the water reached the subgrade—whether by vertical or horizontal capillarity, through seepage strata, from the surface, etc.—is to be emphasized as essential data. If the soil at the surface is wet, very compact, dense and dry below, the chances are that the water penetrated the subgrade from the surface and was forestalled from release by the underlying impervious layer. If the underlying layer of a wet subgrade is moist and porous, and it in turn is underlain with compact pervious clay which is dry, the suggestion occurs that the porous layer is a seepage stratum through which water is flowing and is rising to the top of the subgrade by vertical capillarity.

"It is perhaps true that all soils have adequate bearing value when the amount of water in them is kept to a sufficiently low percentage," says the Bureau of Public Roads, "or it may be possible that certain soils will be susceptible of treatment which will render them of higher bearing value than they have in their natural state.

"It is obvious thati f we are to advance our ideas regarding road construction we must begin with the road foundation and must gain accurate information as to what properties of soils make them good or poor soils for foundation purposes. With this knowledge in hand, we will then be in a better position to say how the road should be designed when it is to be laid on these particular soils, or possibly how we should treat the soil when its characteristics are known in order to increase its bearing value."

### New Metal Alloy

DURING the war an Italian engineer, Adolfo Pouchain, after a series of experiments succeeded in producing a new alloy of zinc and copper, which has been given the name "Biakmetal." This alloy quickly demonstrated its usefulness in Italian industry, and by reason of its special qualities promises to attain similar success throughout the world. Biakmetal has aroused considerable interest in Italy, and we are told by one of the large manufacturers that his metallurgists have made every effort to determine its exact composition, but without success.

From a small beginning the demand for Biakmetal has increased to such an extent that a new company has been formed to carry on its manufacture. The industrial value of a product which is stronger than steel and less corrosive than copper is evident, and it is claimed that Biakmetal, which has passed the experimental stage, possesses these qualities. The most important characteristics are stated to be as follows: (1) The highest known breaking point; (2) the highest limit of elasticity; (3) perfect homogeneity; (4) high resistance to thermic action; and (5) high resistance to chemical action.

In the matter of strength, comparisons have been made between different grades of Biakmetal and copper, brass, and cannon bronze, which showed interesting results. Among these, tests were made of rods of various kinds of metal to determine the weight and size required to give a tensile strength of 500 kilos. The results of these tests were as follows (figures in parentheses represent the diameter of the rods tested, in millimeters, and the other figures, the weight of the rods in kilos per linear meter): Copper (12.6), 1.126; brass (9.5), 0.616; cannon bronze (10.3), 0.723; Biakmetal, No. 3 (6.3), 0.271; Biakmetal No. 6 (8.4), 0.178. (Millimeter, 0.0937 inch; meter, 39.37 inches; and kilo, 2.2046 pounds.)

These figures indicate a surprising superiority on the part of Biakmetal. Where Biakmetal No. 3 is used the same strength is obtained with a diameter and a weight considerably less than those of rods of other metals, while with rods of Biakmetal No. 6, of a diameter less than other metallic rods, the weight may be reduced to a small fraction of that of rods of other metals.

Biakmetal is extremely well adapted for almost any kind of manipulation. It can be successfully cast, turned, drawn, forged, rolled, and stamped. While its development is still in progress, it has already proved especially useful in aeronautic and marine construction on account of its light weight, its unusual strength, and its anticorrosive qualities. In its different forms it may be substituted for steel, brass, and aluminum, and for certain uses has important advantages over these metals.

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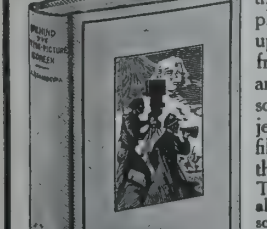

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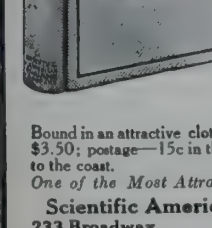

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# Notes and Queries.

Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to Correspondents are printed from time to time and will be mailed on request. Please write your queries: do not telephone them, please.

(14337) The correspondent from 83 Cottage St., Lynn, Mass., is informed that his queries will be answered if he will repeat them signing his name to the letter. We do not answer anonymous letters.

(14338) A. M. asks: Can static electricity be changed to current electricity of low voltage, and how is it done? A. Whenever an electric spark passes across a gap static electricity is transformed into a current of electricity. But if you mean to transform such a discharge into a low voltage current for purposes such as are served by a battery, we should answer in general that such a transformation cannot be made.

(14339) O. C. S. asks: Can you suggest a simple method of testing ink for acid? A. The simplest way to test ink for acid would seem to be to drop into the ink some carbonate of soda (washing soda). Cooking soda (bicarbonate of soda) will answer the same purpose. If the ink is acid it will foam from the carbonic acid which is formed by the action of the acid upon the sodium salt. Probably also blue litmus paper may be used. The black of the ink would hardly stain the paper so much that the red from the acid could not be seen. An acid turns blue litmus red.

(14340) Chas. E. S. asks: I take the liberty of addressing you to ascertain if you know of any process by which the salt can be removed from salt water other than by steaming and condensing so that the water can be used free of salt at low cost. A. We know no way of removing the various salts from sea water in order to obtain fresh water for use, excepting by distilling the water. There are several chemical salts in sea water besides the common salt, which the chemist calls sodium chloride. All of these would not be removed by the same chemical process which would remove the common salt, while distillation will remove only the fresh water leaving all the salts behind.

(14341) F. H. R. says: I claim that anything which will sink in a tub of water will sink to the bottom of the ocean, vessels included. My friend argues that a vessel will sink to a depth of about 4,000 feet and there remain floating between the surface and the bottom. Will you please inform us who is right? Have you any publications for sale which covers this subject? A. Your inquiry has come to us very many times since the sinking of the Titanic and we have several times published the answer. The fiendish work of the submarine revived interest in the subject and now we have recently had a number of inquiries about the matter. Hence we will print the discussion of the topic again. Anything sinks in water when it weighs more than the same volume of water weighs. A cubic foot of fresh water weighs 62.4 lbs. Anything which weighs more than this per cubic foot will sink in fresh water. The density of sea water differs somewhat in different oceans and seas. It may be taken at about 1.03. At this figure a cubic foot of sea water would weigh about 64.27 lbs. Anything heavier than that per cubic foot will sink in sea water. Another most important factor is that water like all liquids is nearly incompressible. So incompressible is it that at the bottom of the deepest ocean, six miles below the surface the water is only 20 per cent heavier than at the surface, and a cubic foot of sea water at the bottom only weighs 77.12 lbs. Anything which weighs more than that per cubic foot will sink to the very bottom of the ocean in its deepest known place. Aluminum, the light metal, weighs 166.5 lbs. per cu. ft.; iron weighs 450 to 480 lbs. per cu. ft.; and stone weighs from 135 to 200 lbs. per cu. ft. Of course they go to the bottom anywhere when placed in water. There is a widespread impression that the tremendous pressure deep in the ocean will prevent sinking. Pressure has nothing to do with the case.

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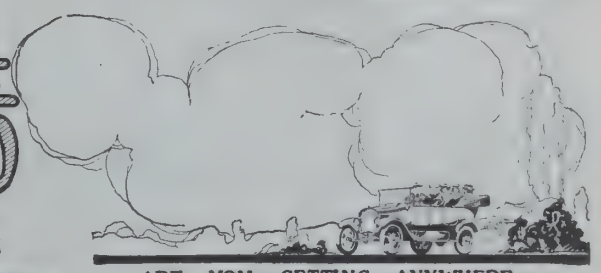
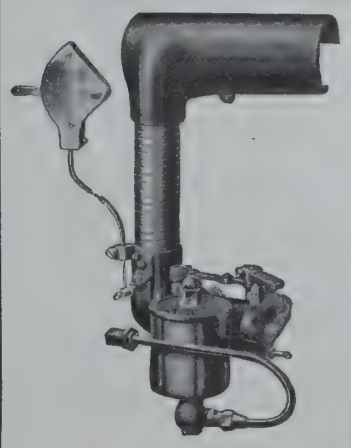


ARE YOU GETTING ANYWHERE NEAR THAT—FROM YOUR FORD?



Suppose you are getting twenty-two miles on a gallon of gas. Then, suppose you increased that mileage to THIRTY. There are eight miles of added travel—motoring that didn't cost you a red cent more than you are now paying—a reduction of approximately *thirty-three and one-third per cent.*

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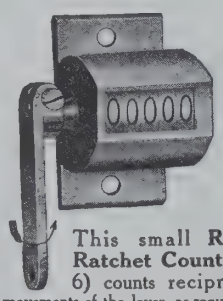

This small **Rotary Ratchet Counter** (No. 6) counts reciprocating movements of the lever, as required in recording the product of stamping presses. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adaptable to no end of small machines, simply by regulating the throw of the lever. Price, $2.00.
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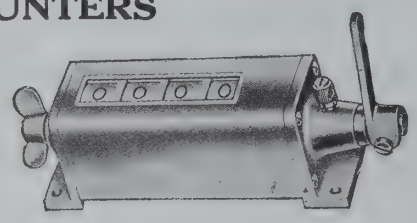

This large **Set-Back Rotary Ratchet Counter** records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra.
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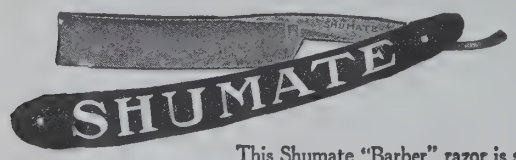


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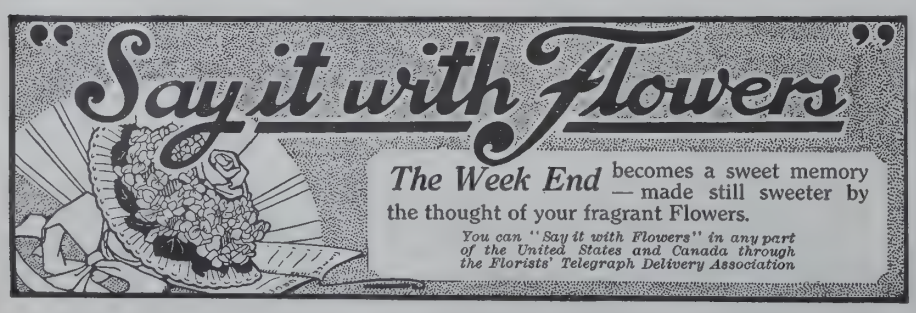


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## NEW BOOKS, ETC.

THE PETROLEUM HANDBOOK. By S. O. Andros, A.B., B.Sc., E.M. Chicago: Shaw Publishing Company. 12mo.; 206 pp.; 48 illustrations; 17 tables.

The many phases of the oil industry are all brought together here, and the fundamentals so concisely presented that the Handbook will appeal to producers, refiners, marketers, jobbers, salesmen, investigators, geologists, engineers and students. It describes all operations from the location of a well to the distribution of the refined products to the consumer, embodies pertinent facts culled from government bulletins and state reports, and forms a most satisfactory nucleus about which to build a library of more specialized works.

APPLIED OPTICS. The Computation of Optical Systems. 2 volumes. Translated and edited by James Weir French, B.Sc. London: Blackie and Son, Ltd., 1918. 8vo.; 377 pp.; illustrated.

The enhanced interest in optical glass in this country, due directly to the lessons of the war, makes a translation of the *Handbuch der Angewandten Optik* of Drs. Steinheil and Voit a valuable addition to the literature of the industry. Indeed, we believe this is the only published work giving a complete and thoroughly practical trigonometrical system of optical computation. The first volume deals with the principles of optics and the derivation of necessary formulae, the determination of simple lens forms, and the calculation of aberrations and combinations. The second volume includes the determination of refractive indexes and dispersions, the computation of achromatic prisms and of doublet objectives, and a dicussion of aberrations of different combinations.

FIRE DEPARTMENT MOTOR APPARATUS INSTRUCTION. By Capt. Daniel A. Sullivan. New York: Civil Service Chronicle. 8vo.; 95 pp.; illustrated.

There are thirty types of motor apparatus in use by the New York Fire Department; Capt. Sullivan, long instructor in the Department's automobile school, describes each type in "firemanic language," with lavish illustrations. Other chapters make clear gas engine parts and principles, the equipment of trucks and hose wagons, tools, lubrication and lubricating systems, ignition, and the theory of the dynamo. It is a complete and readily understandable text that will prove of the greatest service to students of fire department apparatus.

A TEXT-BOOK OF PHYSIOLOGY FOR MEDICAL STUDENTS AND PHYSICIANS. By William H. Howell, Ph.D., M.D., Sc.D. Philadelphia and London: W. B. Saunders Company, 1918. 8vo.; 1059 pp.; illustrated.

This standard work comes to us in a new edition that takes full account of the expansion of physiological and medical research in the past four years. In sifting the evidence for and against new theories, the author's stand is honest and impartial, and time and again he demonstrates his good judgment in stressing only what experiment and experience have sanctioned. In wending his way through the many difficulties that beset any presentation intended for the student rather than the specialist, he has made the path clear for the reader. Accepted fundamentals are vitalized by the new thought-current; the result, in Dr. Howell's skillful hands, is a text of the highest merit.

A HANDBOOK OF AMERICAN PRIVATE SCHOOLS. Boston: Porter E. Sargent, 1919. 8vo.; 761 pp.; illustrated.

The 1920 edition of this annual survey more than sustains its reputation for carefully-gleaned, comprehensive information such as the parent must have before he can choose wisely his child's educational environment. The work is more and more exceeding its original scope. Besides its critically descriptive lists of boys' and girls' schools and summer camps, which include art and trade schools and the private institutions of Canada, with location maps, we find much material of distinct service to school and college executives. There are sketches of history and progress, discussions of educational reconstruction, and a survey of the educational literature of the year past. Beginning with this edition, the handbook now covers not the calendar, but the academic year.

MANUAL OF SUGGESTIONS FOR TEACHERS. By Benjamin C. Gruenberg. Boston and New York: Ginn and Company, 1919. 12mo.; 95 pp.; illustrated.

The teacher who uses the author's "Elementary Biology" will find these suggestions extremely useful in organizing material and ideas, and in the effective presentation of the subject to their classes. It's interpretations, applications and references form a valuable supplement to the original text and to such material as the Department of Agriculture, the Public Health Service and the Bureau of Education issue from time to time.

THE PROTECTION OF METALS FROM OXIDATION AT HIGH TEMPERATURES. By W. E. Ruder. Vol. I. Detroit: Calorizing Corporation of America. 8vo.; 40 pp.; illustrated.

Protective coating processes and the development and application of calorizing are here set forth in brief but exceedingly helpful paragraphs. Leading manufacturers report their experiences with gas-making retorts. tubes and pipe, and the dependable tables offered may be advantageously used in various calculations and operations.

SELECTED ARTICLES ON PROBLEMS OF LABOR. Compiled and edited by Daniel Bloomfield. New York: The H. W. Wilson Company, 1920. 8vo.; 436 pp.

To the investigator of industrial movements and problems, this summary offers a quick way of familiarizing himself with outstanding features of the terrain, and its lengthy bibliography points the road to more thorough exploration. The work brings together in orderly from discussions of friction and unrest, methods of compensation, hours, tenure of employment, trade unionism, disputes and adjustment, limitation of output, industrial insurance, occupational hygiene, and women in industry. Varying points of view are presented, and the trend of the work is constructive.

SELECTED ARTICLES ON THE AMERICAN MERCHANT MARINE. Compiled by Edith M. Phelps. New York: The H. M. Wilson Company, 1920. 8vo.; 344 pp.

This work was first published in 1915 to arouse the interest and answer the questions of those who were following the fortunes of the bills providing for Government participation in the ownership and control of our merchant marine. This second edition adds much material setting forth the situation developed since the creation of the Shipping Board, and takes up the disposal of the fleet. From historical facts to present conditions, the student will find all important questions debated from various points of view by well-qualified disputants. The arguments are preceded by briefs, and there is a good bibliography.

KEY TO THE BIBLE AND HEAVEN. By Ludwig B. Larsen. Portland, Oregon: Ludwig B. Larsen. 8vo.; 280 pp.; illustrated.

The writer regards the Bible as a treasury of astronomical, astrological, and geographical information, and interprets its symbolism in accordance with this belief.

"PRACTICAL ENGINEER" MECHANICAL POCKET BOOK AND DIARY. 1920. London: The Technical Publishing Co., Ltd. 800 pp.; illustrated.

For thirty-two years this British pocket book has catered to the needs of the profession. Data of steam, gas, and oil engines, air compressors, heating and ventilation, hydraulics, etc., are supplied in concise form; in material new to this issue we find information on boiler chimneys, steel stacks, chains and pyrometers. The Buyers' Guide, in French, Spanish and Russian, continues to be a prominent feature.

INTERNAL-COMBUSTION ENGINES. By Wallace L. Lind, Lieutenant Commander, U. S. N. New York: Ginn and Company, 1920. 8vo.; 225 pp.; illustrated.

Lieutenant Commander Lind's text is crisp and business-like in its phrasing, and will be found well-adapted to the average student. One chapter, addressed to readers familiar with thermodynamics, presents the theory of the various cycles. Besides the usual considerations of fuels, combustion, carburetion, etc., there are discussions of the regulation of speed and power, the measurement of power, and the principal enpgine parts and their functions. Aircraft, marine, and automobile types are described, with the cause effect and remedy of troubles.

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# SCIENTIFIC AMERICAN

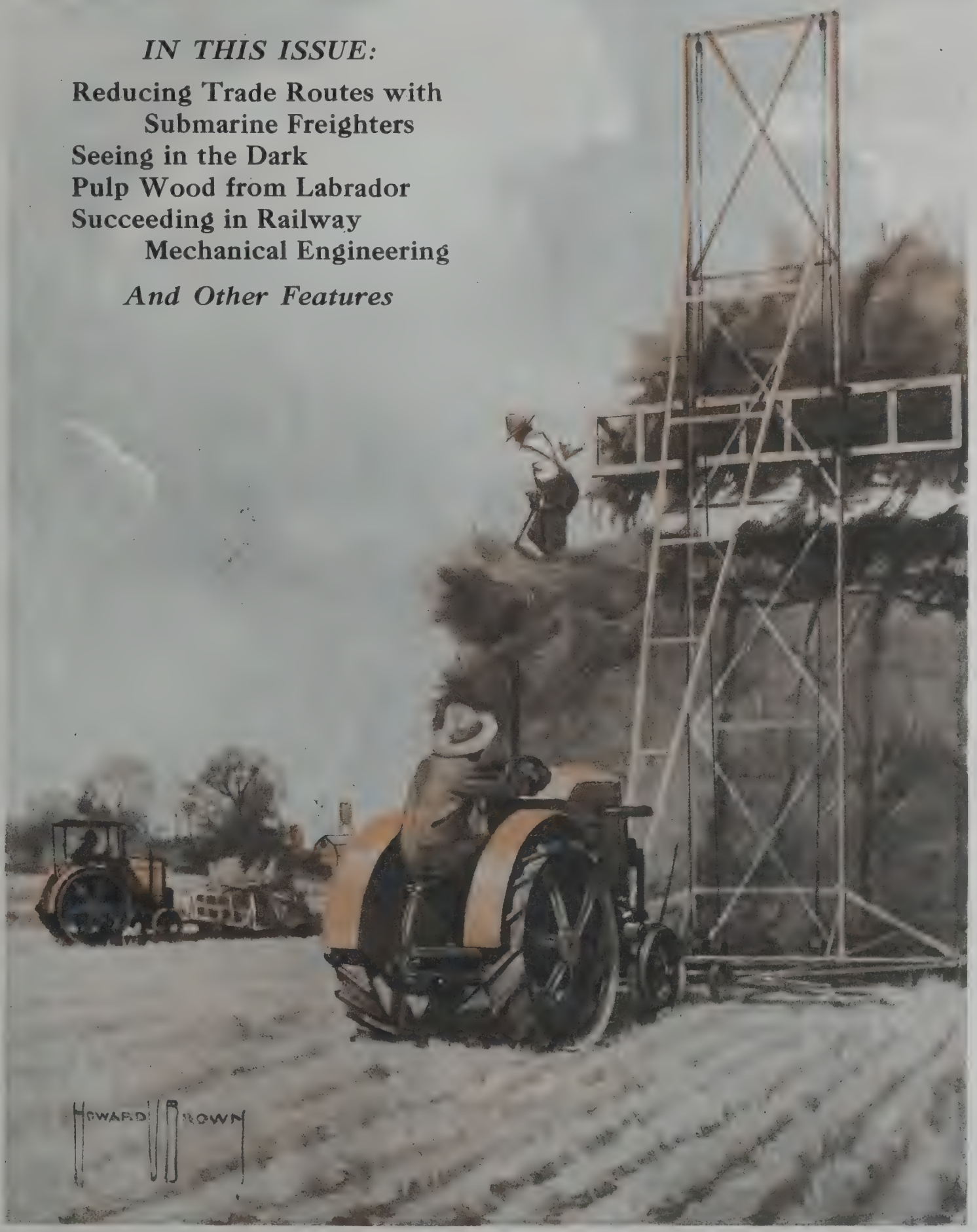
*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

*IN THIS ISSUE:*

**Reducing Trade Routes with Submarine Freighters**
**Seeing in the Dark**
**Pulp Wood from Labrador**
**Succeeding in Railway Mechanical Engineering**

*And Other Features*




SPEEDING UP THE HAY HARVEST WITH THE GASOLINE TRACTOR, RAKE AND STACKER.—[See page 157]

Vol. CXXIII. No. 7
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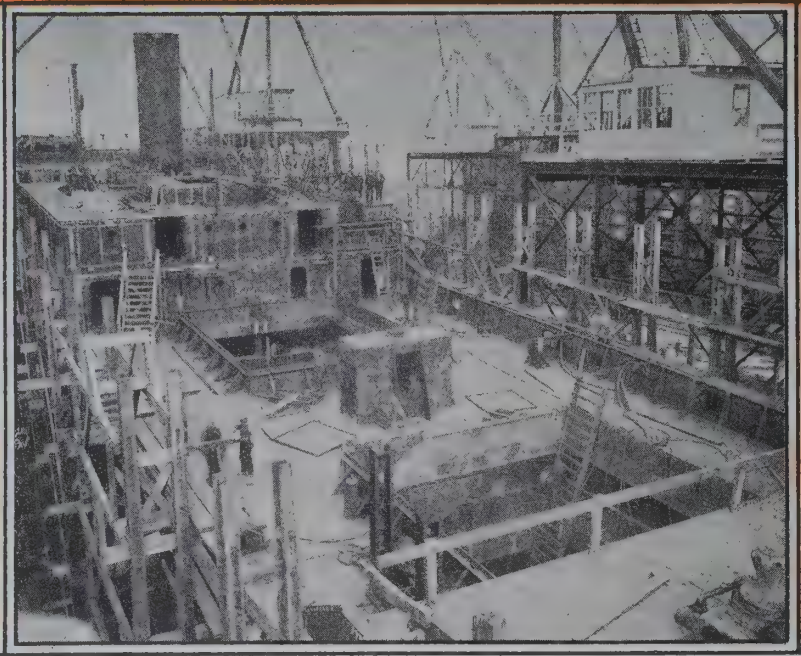
48-10



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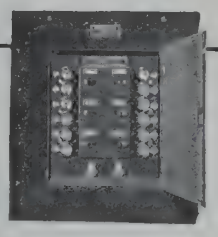

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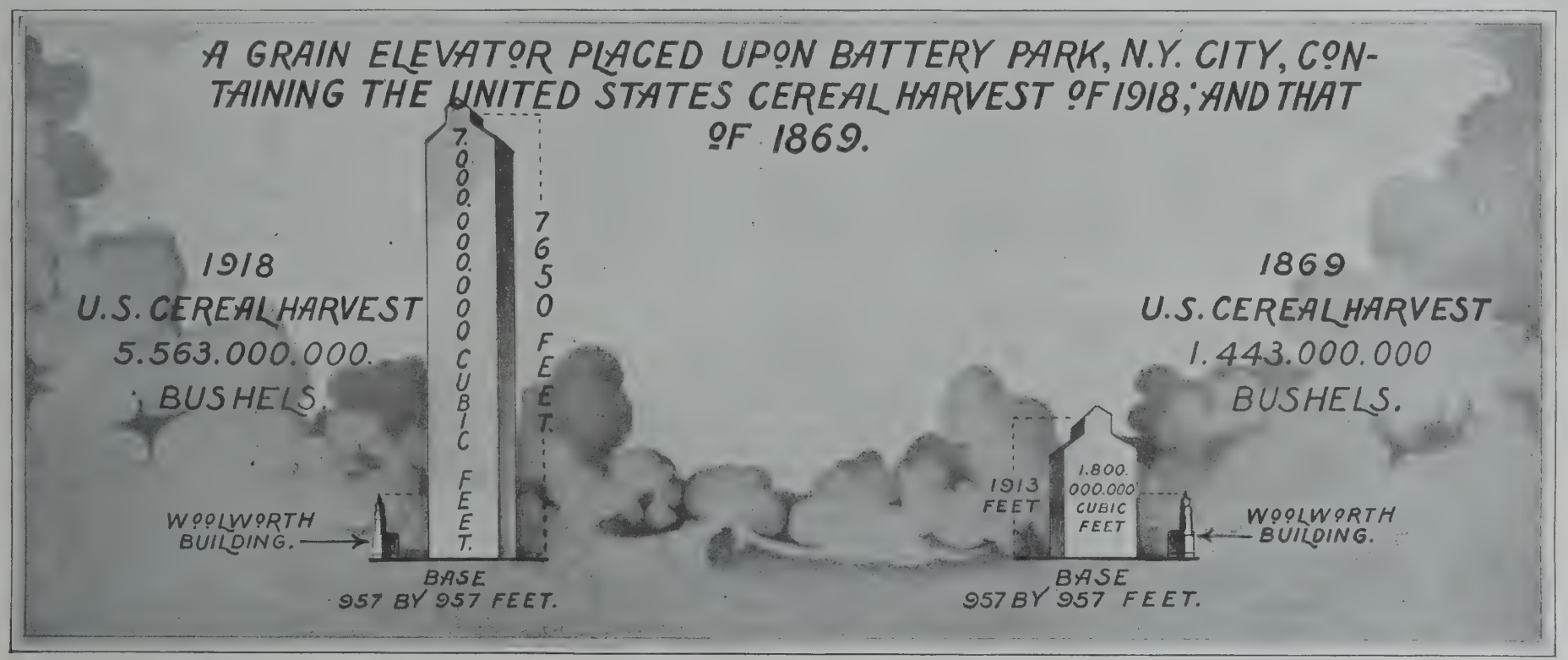
SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 7 ] NEW YORK, AUGUST 14, 1920 [ 15 CENTS A COPY 20 CENTS IN CANADA




**Some idea of the magnitude of our cereal harvest may be gathered from these graphic comparisons showing the crop for 1918 and that for 1869**

## If Our Cereal Harvest Should Descend on New York City

THERE are several cereals such as corn, wheat, oats, etc., and if the total amount of all cereals harvested in the United States should fall suddenly, like a heavy rain, upon New York City, such a cereal deluge would cover the metropolis to a depth approximating 9 6/10 inches. This does not seem very much cereal, but were it to be placed upon Madison Square it would then approximate a height of more than 4 miles! And, further, were all this cereal harvested in the United States to be placed in Madison Square upon a base having an area of 100 square feet, that is, a base 10 feet long by 10 feet wide, and then to be toppled over, it would fall, were it to be solid like stone, to a distance equal to about that of 5 times to San Francisco. Or, in other words, one year's cereal harvest in our country would, on a base containing an acre of land, rise to approximately the same height as would 214 Woolworth Buildings, placed one upon another.

Moreover, this annual cereal harvest would fill a street 100 feet wide running from the Battery to 44th Street to a height of about 3,315 feet; or a street 200 feet wide running from the Battery to near the city line to a height of about 432 feet; or a street 1,000 feet wide from the Battery to the City Hall to more than 1/3 of a mile. It would bury Union Square to a depth of 750 feet and there would be enough left of our country's harvest to bury City Hall Park under almost 4 miles of cereals. If our national cereal harvest should descend wholly upon Central Park it would bury that park to a depth of approximately 190 feet. And if this storm of cereals should descend upon New York City at the rate of one million bushels a day it would not cease falling upon that city for 19 years, that is, it would fall without stopping from 1919 till 1938. The accompanying graphic comparison, showing our cereal crop for 1918 and that for 1869, speaks for itself. It tells the story of our production.—By *Charles Nevers Holmes.*

## Phosphoric Acid and Potash Now Produced

ALMOST unusual and novel application of electricity has recently been introduced commercially. It is the direct result of experience gained during the war and is a new use of electric furnaces regularly employed in metallurgical operations.

There are two types of electric furnaces used in the steel industry—one is the regular melting or refining furnace for making steel; the other is the shaft furnace in which most of the ferroalloys are made. A southern ferroalloy company, which, during the war made ferromanganese and several other alloys, found itself confronted with severe competition after the armistice and with the problem of finding a profitable use for its expensive equipment. The result of extensive investigations has been the following unique use of these furnaces.

The new departure involves the manufacture of phosphoric acid and of potash. The former has been made and is now being made by chemical processes on a large scale. Its electrical production is new, especially by the means referred to. Phosphate rock is put in the shaft electric furnace and smelted or disintegrated by the electric cement. Phosphoric oxide or $P_2O_5$ is formed, which passes off as a gas or in the gases. These are collected in chambers, and electric currents of high power are passed through the gases from which the phosphoric acid is precipitated as a powder. This is an application of the Cottrell electric precipitation method recently described in these columns. In this manner an unusually commercially-pure product is obtained free from many of the impurities introduced when sulfuric acid is the disintegrating medium acting on the rock instead of electricity. This product is further treated and concentrated.

In the case of potash the shale rocks of the Southern States, which are high in potassium compound, are introduced into the same kind of furnace and treated similarly. The product of this electrical disintegration is potassium oxide or potash, $K_2O$, which is also precipitated electrically from the gases which are evolved. Both of these products are valuable as fertilizers and the use of this process has a bright future.

The use of electricity in these two interesting cases instead of expensive chemicals is not only a feature of this new departure but there is the other novelty that electricity is used both as the destroying or breaking-down agent and as the medium by which the final products are recovered.

## Hawaiian Motors Run on Molasses

FROM the lowly and sticky molasses is being produced "motor alcohol"—a substitute for gasoline. Discovered by J. P. Foster, chemist of one of the big sugar plantations on the Island of Maui, Hawaii, production within the next three months will be sufficient to furnish fuel for all cars on the islands should a gasoline shortage occur. According to the first reports of the new fuel brought to San Francisco "motor alcohol" gives more power, greater mileage, easier starting and more freedom from carbon than gasoline. It can be used without an adjustment of the carburetor.

The new fuel is performing in automobile, marine, stationary, truck and tractor engines. In a 36-hour test made with a 75-horse-power tractor the consumption of "motor alcohol" was four gallons an hour compared to four and a half gallons of gasoline in the same engine on the same work. Examination of the cylinders showed most of the old carbon deposit removed and the remainder so soft it could be removed with the fingers.

Sugar plantations have been letting their molasses run to waste or burning it for the potash recovery. Nitrogen and phosphoric acid are also valuable by-products of molasses. Now, however, production of the new fuel is found to be more profitable than obtaining other by-products.

At present there is enough molasses available to produce 9,000,000 gallons of "motor alcohol"—enough to supply all automobiles in Hawaii. Development of this industry will release shipping space formerly used for transporting gasoline from the United States.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## A Prediction and Its Fulfilment

WE offer no apologies for republishing in this issue an article which was written ten years ago in a special aviation issue of the SCIENTIFIC AMERICAN that was brought out during the famous aviation meet at Belmont Park, in October, 1910. That meet was memorable because for the first time America was afforded an opportunity to see the very latest developments in aviation; for the best machines and the most noted fliers, both here and in Europe, were gathered at Belmont Park. Records were broken; and both as to speed of machines and skill of pilots, the gathering was literally, at that date, the last word in aviation.

The article was written without any wish to depreciate the skill either of the builders of the airplanes or of the pilots who flew them. Rather, it was stimulated by the conviction that the airplane development of that day was too much in the hands of the amateur, and, as invariably happens in such a case, successive machines too closely followed the lines of previous development. The writer felt satisfied that when the scientist and the practical engineer, as represented by Langley and Manly of the Potomac experiments, took up the work of development in good earnest, there would be a radical change from the curious and complicated constructions which prevailed at Belmont Park, with their multiplication of struts, ties, braces and other energy-consuming surfaces, and the airplane would be brought to its ultimate bird-like shape and fabricated in the wonderful constructional alloy steels which even in that day were available.

It is with a very natural satisfaction that we have witnessed the appearance, first in Germany, and later in this country, of the all-metal monoplane with its corrugated wing surfaces and its freedom from external struts and ties. The folding chassis as we then called it, retractable chassis as it is now known, has come into its own. Gyroscopic control of the ailerons as then predicted has been developed in practical form, and streamlining, as indicated in those early sketches, is now a *sine qua non* of all good airplane design.

By analogy, it is probable that the monoplane will be restricted to the smaller and medium sizes of machines. Plate girders can be used in railroad bridges only up to a certain length of span; above that length, the economics of construction call for the truss. So it will probably be found that although the monoplane is ideal for the smaller machines, the trussed biplane or triplane will be necessary when the wing span and the weights exceed certain figures.

If the development of the past decade has brought us to the stage of the perfectly streamlined metal monoplane, what will be the development of the next decade? We do not hesitate to predict that there will be more attention directed to the motive power and the propeller than to any other elements of the airplane. The internal combustion engine, even in such highly efficient and reliable types as the Rolls-Royce, the Liberty and the Hispano-Suiza, is far from being an ideal airplane drive. It is noisy beyond all endurance, and in spite of the reliability shown in some of the recent flights, it does not possess the rugged durability and the absolute dependability which are demanded for a machine which becomes a comparatively inert mass the moment its engine ceases to function. For this reason, we believe that aeronautical engineers will turn their attention increasingly to that well-tried prime mover, the steam engine. With this will be coupled some type of feathering reversible propeller, which will be equally efficient at all altitudes, and will provide that powerful braking action, which is necessary to make the landing of an airplane as safe as its taking off.

## Hudson River Bridge as a War Memorial

AS far back as the days of those master builders, the Romans, it was recognized that there was an inherent dignity and permanence in a bridge of proportions, which rendered it admirably adapted to serve as a memorial to great national achievements. An added fitness for memorial purposes is found in the fortuitous fact that the engineering requirements of bridge construction call for a distribution of materials which lends itself to great beauty of line and an impressive grouping of mass proportions. And not alone in the ancient world and in mediaeval times, but in our modern age of steel the bridge has held its place as a worthy form of memorial; some of the finest crossings of the great rivers of Europe having been dignified in this way. It was altogether natural therefore that the Mayor's Committee on Permanent Memorial should have voted by a large majority in favor of making the great bridge which is to be built across the Hudson, a memorial to the soldiers of New York who took part in the World War.

Even if bridge memorials did not have the sanction of the centuries, the selection of the Hudson River bridge must necessarily appeal to our imagination and to our general sense of the fitness of things. As the recent conflict was the greatest war in all history and our share in it was the supreme military effort of this country, it is fitting that this structure, which will be beyond all comparison the greatest single feat of engineering in this age of steel, should receive the added dignity of serving as a permanent national memorial. Architecturally it will meet every requirement of impressive magnitude, classic beauty, and assured permanence. Its great central span of 3,200 feet is just twice the length of the Brooklyn bridge, measured from tower to tower. Spanning as it does the noble river which, more than any other, is associated with the early history of the country, and looking down upon the river front from which our soldiers set out for the battlefields of Europe, it will be most aptly situated to fulfil the demands both of history and sentiment.

And it so happens that the masonry anchorages, which in a bridge of this size are necessarily of enormous proportions, lend themselves with peculiar facility to architectural and structural treatment of a memorial character. The anchorages which form the portals of the bridge will be masses of granite masonry, 220 feet in width, 340 feet in length, and over 200 feet in height. The upper deck of the bridge will contain in the center of its 200 feet of floor width a boulevard 80 feet wide, and entrance to the bridge will be made through three great arches in each anchorage —a central arch 100 feet wide, with side arches of half these dimensions, all three of these being executed in sculptural stone. After passing through these arches, there will be visible the four steel cables, each eight feet in diameter and covered with bronze plating, which will sweep in great curves to the top of four towers, each 650 feet in height. Although these towers will be built of structural steel, the steel work will not be visible, since they will be clothed from water level through the whole up-curving sweep of them with gray granite, each tower forming a tapering octagonal shaft, second only in height to the Woolworth tower, and many feet loftier than the Singer tower. The group of four towers will be pierced with three arches, granite or marble covered, of noble proportions, through which entrance will be had to the main span with its vast sweep across the river of 3,200 feet. The approaches from the Jersey side will be similar. It can readily be seen that the vast masonry surfaces will suffice for a display of sculptured emblematic and memorial work and bronze tablets on a scale commensurate with the dignity of the subject.

The designer of the Hudson River bridge, Gustav Lindenthal, wishes it to be clearly understood that the bridge as an engineering proposition will be built with private capital, and that the cost of the memorial features, only, will be borne by the city.

## Is Naval Design in the Flux?

ARE naval design, construction, strategy and all the rest of it in a state of flux? When Beatty led the German fleet into contact with the British, Jellicoe, with twenty-five battleships, had the speed and power to close in and absolutely annihilate the Germans. Why did he not do so? Because of his very proper fear of the torpedo. He escaped torpedo damage by keeping the German destroyers at such a distance that their torpedoes were discharged haphazardly, lost their speed before they reached the British line, and were easily avoided by maneuvering.

Have you ever considered that the gas engine is liable to upset many of the theories and practices of naval construction and warfare? It is a thought well worth consideration, and we invite attention to it just now.

Is it not rather strange that the British should have scrapped half their battleship fleet and stopped all battleship construction? And that they should so complacently sit down and watch another navy spending seven hundred and fifty million dollars on eighteen battleships and battle-cruisers which, theoretically, when completed, will wrest from her that protective supremacy at sea which she has always believed, and still believes, to be necessary to the security of her far-flung empire? Why this complacency? If you asked Admiral Benson, he would probably answer "They are hard up. It is necessity." But can we be so sure of this? Is it not possible that their vast war experience showed the British that the terrific punishing-power of the torpedo, due to new methods of bringing it within point-blank range of the enemy, demands a radical revision of some of our fundamental war concepts?

We believe that in future war the torpedo will at last come into its own, and it will be the internal combustion engine that will work the change. It gave us the motor car and the airplane, and now it is perhaps destined to dethrone the battleship and battle-cruiser as the supreme elements of naval strength. But how? Well, the British have several large and fast torpedo-plane carriers. Let us forecast a duel between a twelve-gun, 23-knot "Massachusetts," and a 32-knot torpedo-plane carrier, with twice that number of planes aboard. Steaming outside of 16-inch gun range, the carrier would send in her planes which, swooping down from great height at 150 miles an hour, would drop their torpedoes within close range and return for more. But the bulge will save the ship? No; for the torpedoes will be set to pass underneath the ship and they will be fired magnetically by the action of the steel mass of the ship itself. And you could not put side and bottom bulges, both, upon a ship—she would be all bulge and but little ship.

Again, the internal combustion engine has opened up another form of attack in the shape of the so-called one-man torpedo boat—a type which is coming along very fast. It begins to look as though the gas-driven, high speed, motor boat, carrying its torpedo discharge below water, would fulfil the functions in which the torpedo boat failed utterly and the destroyer partially. It has the torpedo efficiency of the destroyer without its size and visibility. To hit, the torpedo must be fired at close range—the Germans found that out at Jutland. The torpedo motor boat is so small a mark that it can dash in at thirty knots to within point-blank range without the anti-torpedo gunner being able to draw a bead upon it, so rapid is the change of range; and twenty sea-going motor boats can be sent in for the cost of one destroyer.

Seaworthiness? Well, they are growing in size, and the latest type would have no difficulty in keeping station as part of a fleet organization.

There are evidences, clear to the close student of naval development, that naval theory, construction, strategy and tactics are very much in the flux just now, or soon will be.

## Electricity

**Collapsible Tool Bag for Linemen.**—There has recently been placed on the market a canvas tool bag for use in hoisting tools, paint and other implements or supplies by linemen. The bag is made with no metal parts that can come in contact with the current, as the sides are of canvas, the bottom is of wood, and the handle is of rope. The manufacturers have designed it to hold tools and materials which, if not properly taken care of, may be a menace to those below.

**An Electric Pipe Thawer.**—It is hardly seasonable to be speaking of pipe thawers; but winter must come sooner or later and pipe thawers are equipment which cannot be left to the last moment. There has been placed on the market a pipe thawer in a highly portable form. It consists essentially of a transformer, consuming ordinarily about 550 watts, a 10-foot lead for connection to the lighting circuit, and secondary leads equipped with cast-brass clamps for attaching to pipes from ½ to 1 inch diameter. Alternating current of 50 cycle to 60 cycle frequency and 100 to 125 volts is used. The spread of the secondary is 15 feet.

**The Sheringham Daylight Lamp.**—Owing to the variable intensity and color of daylight, according to season and climatic conditions, an artificial illuminant giving light equivalent to that from a diffused north sky would be of great value in many color-matching operations. In the Sheringham device a glow-lamp (or other illuminant) is placed under a large shade the inner surface of which is covered by a special design in colors. The lower half of the lamp is screened by a reflector which directs light upward on to the mosaic of colors, whence it is diffusely reflected. The colors can be so selected that the reflected light closely resembles diffused north skylight, light from a blue sky, or sunlight. A diagram is given showing the spectrum distribution of light from a blue sky, noon sunlight, a tungsten lamp, and the artificial daylight produced by the Sheringham lamp. The efficiency of the unit is stated to compare favorably with that obtainable from previous methods of producing artificial daylight.

**Intensity of Wireless Signals.**—A method of measuring and comparing the intensities of signals received by a radio station has been worked out in France with good results. This method, which can be employed only for undamped waves, essentially consists in comparing the intensities of reception of the signal and of the sound produced by a local source of oscillations, of the same frequency and form, constituted by an ordinary heterodyne. By modifying the intensity of the action of the auxiliary oscillation-generating device upon, say, the antenna, a rough equalization is first obtained, afterwards, by maneuvering convenient shunts to the telephone an absolute equality of intensities is obtained. The ratio of intensities is proportional to the shunt resistances. Moreover, by inserting a thermo-galvanometer in the antenna the absolute value of the intensity of the auxiliary signals can be obtained. The error in the practical use of this method is from 5 to 10 per cent.

**France's Wireless Plans.**—A dispatch from Paris states that the French Government has recently announced plans for an elaborate wireless system whose center will be in Paris and which will cover Europe, Asia, Africa and South America and connect with North America. If this system, part of which is already in existence, is integrally applied as now proposed, France's wireless communications throughout the world will be able to rival with Great Britain's cable communications. According to the details made public at a recent meeting at Rennes, wireless communication was established with Hungary May 20, 1920, and will soon be opened with Belgrade. For commercial communication with the United States there is a station at Doua, near Lyons, in addition to the Lafayette station near Bordeaux. Between France and its colonies there will be stations with a range of 7,500 miles at Saïgon and at Tahiti. Stations with a radius of at least 4,375 miles will be established at Djibouti, Tananarivo, Noumea, and French Guinea. In Africa the system will include stations at Saida and Bamako, which will take care of the traffic between Paris, Algeria and West Africa; another station in Senegal, near Dakar, and finally that of Brazzaville.

## Science

**Collection of Aeronautical Instruments.**—The official collection of aeronautical instruments maintained by the Bureau of Standards in Washington is said to be one of the most comprehensive in the world. It includes instruments of French, German, British, Italian, Russian, Swiss, Danish, Dutch and Austrian manufacture as well as those made in America.

**Biochemical Research at Cambridge.**—The University of Cambridge has received from the estate of the late Sir William Dunn a large fund to be used in endowing biochemical research and instruction at the university. A minimum total expenditure of $825,000 is contemplated for the erection and equipment of buildings and the endowment of a professorship and a lectureship.

**Marine Laboratory in Hawaii.**—The University of Hawaii has received a fund from the C. M. Cooke estate which is to be used in establishing a marine biological laboratory in connection with the Honolulu Aquarium at Waikiki now under the supervision of the university. Facilities will be provided for work by visiting scientific men. Biologists who wish to use the laboratory should communicate with Prof. C. H. Edmondson, the director.

**The Mango in Florida.**—The U. S. Department of Agriculture has secured through its agricultural explorers and by exchange with the British East Indian departments of agriculture one of the largest collection of mango varieties in the world, and now has in fruit, at its plant introduction station at Miami, Fla., about 20 varieties, selected from a much larger number. It is said that these selected varieties strikingly belie the many unkind things that have been said about the mango and that are really applicable only to the inferior sorts. Some of them have hardly more fiber in them than a freestone peach, and can be cut open lengthwise and eaten as easily with a spoon as a cantaloupe. They have a delicious odor, suggestive of pineapples. The mango is destined to become one of the important products of southern Florida, south of the line of heavy freezes.

**The Reappearance of Minerva.**—The 1920 issue of the *Minerva Jahrbuch der gelehrten Welt* has recently appeared, this being the first issue since that for 1913-14. It was expected that this unique international directory of scientific establishments and their staffs might be made superfluous by the publication of the new French *Index Generalis*, but as the latter (judging at least from the initial volume) is only a directory of educational establishments, the two works do not cover identical ground. The latest *Minerva* is extremely incomplete for many countries, and for obvious reasons, but contains addresses and statistics not available from other publications pertaining to the scientific establishments of Germany, Austria and Hungary, besides much information relating to Switzerland, Denmark, Sweden, Norway, Holland, Bulgaria, Esthonia, Czecho-Slovakia and a few other parts of the world. *Minerva* is now published in Berlin and Leipzig, instead of Strassburg.

**Rasmussen's Studies of Eskimos.**—The remarkable studies carried out by the Danish explorer, Knud Rasmussen, among the Greenland Eskimos are described by Mr. W. E. Ekblaw in the *Geographical Review*. Rasmussen, who is part Eskimo himself, was born and partly educated in Greenland and trained in languages and ethnology at the University of Copenhagen. It is his ambition to make a thorough study of the whole Eskimo race, from eastern Greenland to Siberia, and he has already visited every Eskimo settlement in Greenland. It is said that he knows every Greenland Eskimo personally. Mr. Ekblaw believes it safe to say that no one else has ever come into such direct contact with a whole people as he has. Late in 1919 he returned from a visit to Ammassalik, on the east coast. He was surprised to find that the East Greenland Eskimos preserve many of the customs of the Central Eskimos, who still inhabit the ancestral home of the race about Hudson Bay. He found that they are more closely related to the Central Eskimos than are any of the other tribes of the entire Greenland coast, and that only recently have they been affected by contact with the Greenland west coast culture.

## Industrial Efficiency

**Tanned Sponges.**—An interesting process has recently been developed for increasing the efficiency and extending the life of sponges used for technical purposes, automobile washing, office use, etc.—in fact for all purposes except use on the human anatomy. It consists in a modified tanning process, and it makes the sponge take the water much better and act more satisfactorily in giving it up to the work.

**Our Business in India.**—With the United States and Japan each maintaining advantageous business in India and British manufacturers endeavoring to regain their pre-war position in this market, competition is keen for the trade of that country, accordng to the *Trans-Pacific*. Textiles and machinery mainly from England, cotton hosiery, silk piece goods, and glassware chiefly from Japan, and electrical machinery and automobiles almost entirely from the United States, supply India's demands in these lines at present. The importation of paper from the United States during the last year greatly increased, and American manufacturers successfully furnished the Indian market with supplies of hardware, bolts and nuts, nails, rivets and machinery and mill furnishings generally.

**New Uses for Stainless Steel.**—Since the Armistice there has been an enormous sale of stainless steel for cutlery purposes. The demand is increasing, and the labor and machinery in the Sheffield cutlery trade are inadequate to deal with the influx of orders. Stainless steel is being employed very largely in the manufacture of pump rods, valve spindles, valves and other parts which are exposed to contact with water, steam and other corrosives. The scientific instrument trade is using it for drawing instruments and other precision tools and for surgical instruments. It is being manufactured into stair rods, saucepans, and pans of varying shapes, fenders for the hearth, and even into pokers and garden implements; and butchers' rails, spikes, skewers, saws, and other butcher-shop requirements are being made from it. Stainless steel is also being used for golf-club heads, spurs, etc.

**Long-Distance Rafting.**—Swedish lumbermen are on this coast investigating the possibility of rafting lumber from British Columbia to Europe. Lumber rafts of large size, called rafanutes, have been successfully towed from Sweden to Great Britain. The Ocean Rafanute Syndicate, of London, England, has sent William Olsson, of Stockholm, an experienced rafanute builder here, to investigate the possibility of adapting that method to British Columbia timber exports. The rafanutes are made of squared timbers. Mr. Olsson, though expressing nothing definite, believes that the tremendous timbers of the British Columbia forests will make possible the construction and successful operation of rafanutes far larger than the rafts now shipped out of the Baltic. Swedish structures carry four or five million feet each. It is proposed that the British Columbia rafts will contain fifteen to twenty million feet.

**Wanted: New Uses for Rubber.**—The Rubber Growers' Association of London is offering certain sums of money, as below, for ideas and suggestions for extending the present uses or for encouraging new uses of rubber. The awards consist of: First, £5,000; second, three prizes of £500 each; third, ten prizes of £100 each, and a sum not exceeding £1,500 to be divided among the remaining competitors whose suggestions are considered to be of value, according to the relative value of their suggestions, but so that no competitor will receive more than £100. The association points out that "suggestions must be practical and likely to increase the demand for the raw material. Ideas will be welcomed for the application in new directions of existing processes, methods, or manufactures, or for improvements or new processes which will facilitate or cheapen the production of rubber goods. Competent judges (technical and otherwise) will be appointed to investigate and adjudicate upon the suggestions received." The latest date for receiving suggestions is December 31st, 1920, and no envelopes containing the same will be opened before that time. Full particulars of the conditions governing this competition can be obtained from the Rubber Growers' Association, 38 Eastcheap, London, E. C., 3. England.

# Reducing Trade Routes with Submarine Freighters

## How a Special Type of Submarine Might Be Employed for Traversing the Arctic Ice Fields

By Robert G. Skerrett

THE Northeast and the Northwest Passages, with their strong appeal to the venturesome navigators of other days, are likely to be turned to thoroughly practical commercial account in the near future, thanks to potential developments in the realm of under-water travel.

In the course of the last five years the submarine evolved from a coastal or harbor defense craft into a vessel capable of taking to the high seas and holding her own in the open ocean for weeks' running. But probably no phase of this department of naval architecture has been more suggestive than that typified by the German subaqueous freighter "Deutschland" of something like 1,700 tons. Simply because she was the lone example of her class to reach our shores and to win any considerable notoriety, little heed has been given to the significance of her performances.

Simon Lake, however, is thoroughly convinced that the cargo-carrying submarine has a conspicuous and a valuable part to play in peace-time trade; and he has brought his wide experience in subsurface navigation to bear in designing a submergible freighter especially suited to following routes normally considered closed to the average merchant steamer. In these days when labor is high; when the world cries aloud for an abundance of raw materials; and when time, indeed, means money, any agency which will shorten the journey of essential commodities, will abridge the transit period, and, in effect, bring widely separated points on the globe much nearer together, will prove a veritable boon.

Despite the fact that Sir Robert McClure, during his expedition of 1850-54, proved that ships might pass from the Atlantic into the Pacific by threading the Arctic waters washing the northermost shores of North America, and that Nordenskjold, in 1878-79 was able to complete a kindred voyage along the frigid coasts of Europe and Asia thence to the Pacific Ocean, nothing more than scientific interest has since been centered in these regions mainly because barriers of ice interpose more or less at all seasons to make progress there too hazardous, tedious, and uncertain for the bustling craft of commerce bent upon reaching her destination with dispatch. Further, marine underwriters, knowing the risks to be run, would not have insured either the vessel or her cargo. Therefore, oversea traffic has followed for generations longer and, withal, safer routes. But what has been done in the past is not necessarily a conclusive guide for the future, and Simon Lake proposes taking advantage of those northern waterways which have heretofore excluded the average mariner.

True, the longest way round is at times the shortest, allowing for circumstances that otherwise might occasion delay. Let us see what this actually means so far as separating distances are concerned. Suppose, for example, that the object is to carry goods from New York to Cape Nome, Alaska, and then to bring back a return load to the American Metropolis. The trip, outbound, via the Panama Canal, would mean a voyage of 7,945 nautical miles. To reach the same Alaskan port by way of the Arctic Ocean—entering the Pacific by Bering Strait—the run would be 6,660 knots, a difference of 1,285 miles, or 2,570 knots in a round trip. Again, imagine a steamer bound from Liverpool to Nome. Today, if she goes through the Mediterranean, using the Suez Canal to reach the Indian Ocean, and thence into the Pacific and northward off the eastern shore of Asia to Alaska, she must trace a route 13,705 miles long, whereas 9,280 miles might be saved on a single run if she could make the voyage through the Arctic Ocean! Of course, the journey could be shortened 1,715 miles by crossing the Atlantic, using the Panama Canal and thence up the west coast of North America, but this would still be 7,565 miles more of a run than the route through the northern waters. It calls for no stretch of the imagination to visualize the time and the money that might be saved by abandoning the established lanes of deep-sea transportation.

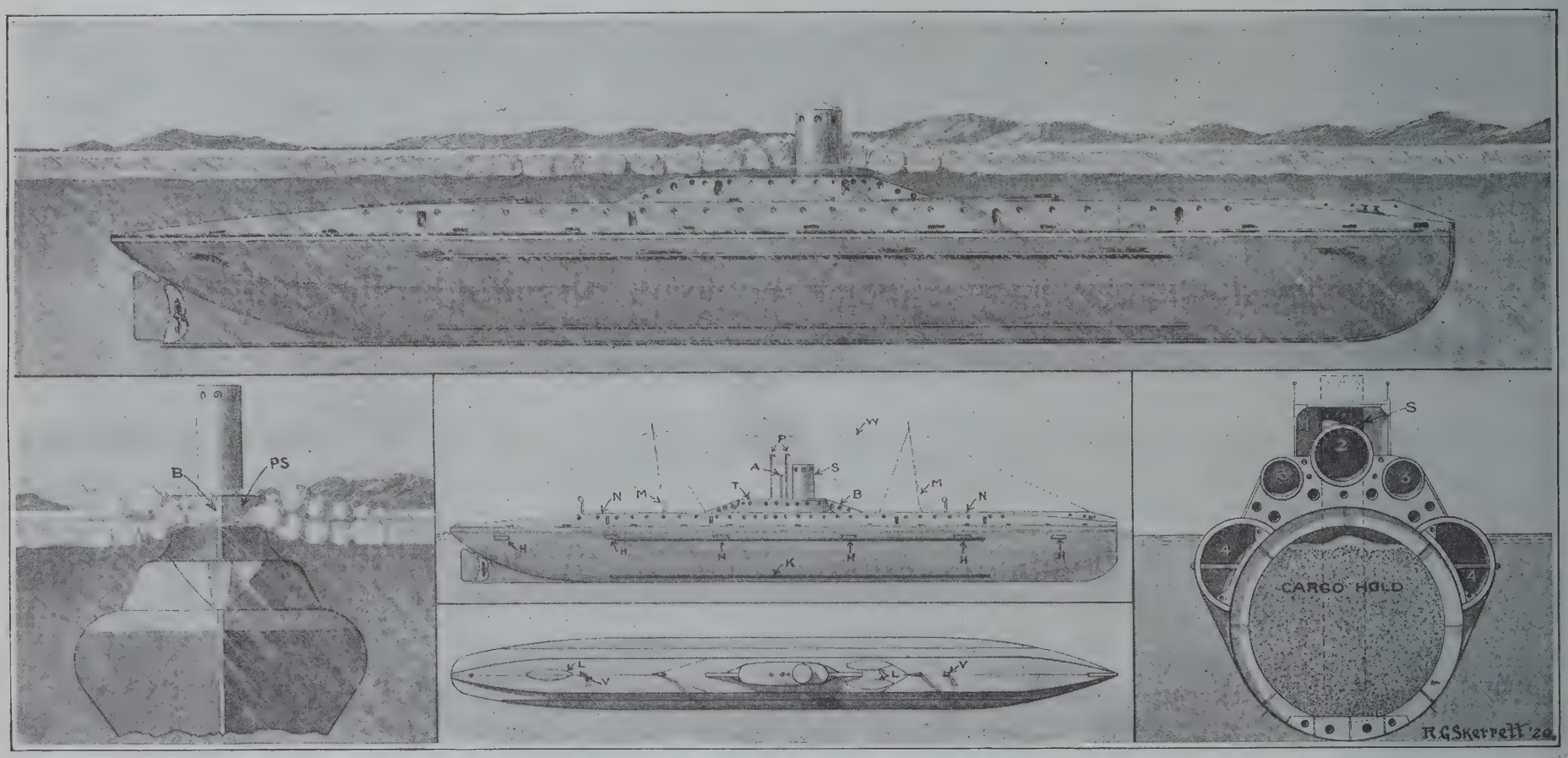
The practicability of the northern route is founded upon data furnished by well-known Arctic explorers and upon Mr. Lake's own experience some years ago with a submarine torpedo boat which he sold to the then Imperial Government of Russia. During the severe winter of 1903-04, the craft in question was operated in Narragansett Bay, and on several occasions she was run beneath heavy floes of ice. To facilitate maneuvering of this sort, the submarine was equipped with an overhead skid or guard which made it an easy matter for her to skate, so to speak, on the nether surface of the overlying ice.

According to information furnished Mr. Lake by such men as Scott, Nansen and Steffanson, and confirmed by Nansen in his well-known book, it seems that ice in the Arctic Ocean does not exceed a vertical thickness of more than 14 feet in the winter season, and fields of ice are never more than 25 miles across before there occurs a stretch of open water. In the summertime it has been the watery breaks and the presence of slush ice which have hampered the Arctic traveler—neither walking nor paddling being possible except under extreme difficulties. These are the physical conditions which Mr. Lake counts upon turning to his advantage. His intention is to operate his submarine cargo carriers in the summer months when the ice has broken up and become more or less rotten. It is said that icebergs do not prevail in that area of the Arctic Ocean contiguous to Siberia and North America and they probably would occasion trouble only when traversing Baffin Bay and the approaches to Hudson Bay. These, of course, would be seen and avoided while at the surface. The purpose of the submarine is to under-run ice jams, wide and solid floes, and not to dive beneath bergs.

The submersible freighter planned by Mr. Lake would have an overall length of 395 feet, a molded beam of 45 feet, and a molded depth of 42 feet, displacing, when fully submerged, 13,000 tons. Under water, the vessel would be driven by electric motors, drawing their energy from storage batteries, giving a speed of 3 knots an hour; and on the surface the propelling mechanism would be an engine of 1,500 indicated horse-power functioning a single screw. This engine may be either a turbine or an ordinary marine reciprocating type using steam or, possibly, a heavy-oil Diesel motor. In any case, the surface speed would be 10 knots an hour.

While the idea is to travel submerged in contact with the under surface of the ice, the boat would

(*Continued on page 164*)

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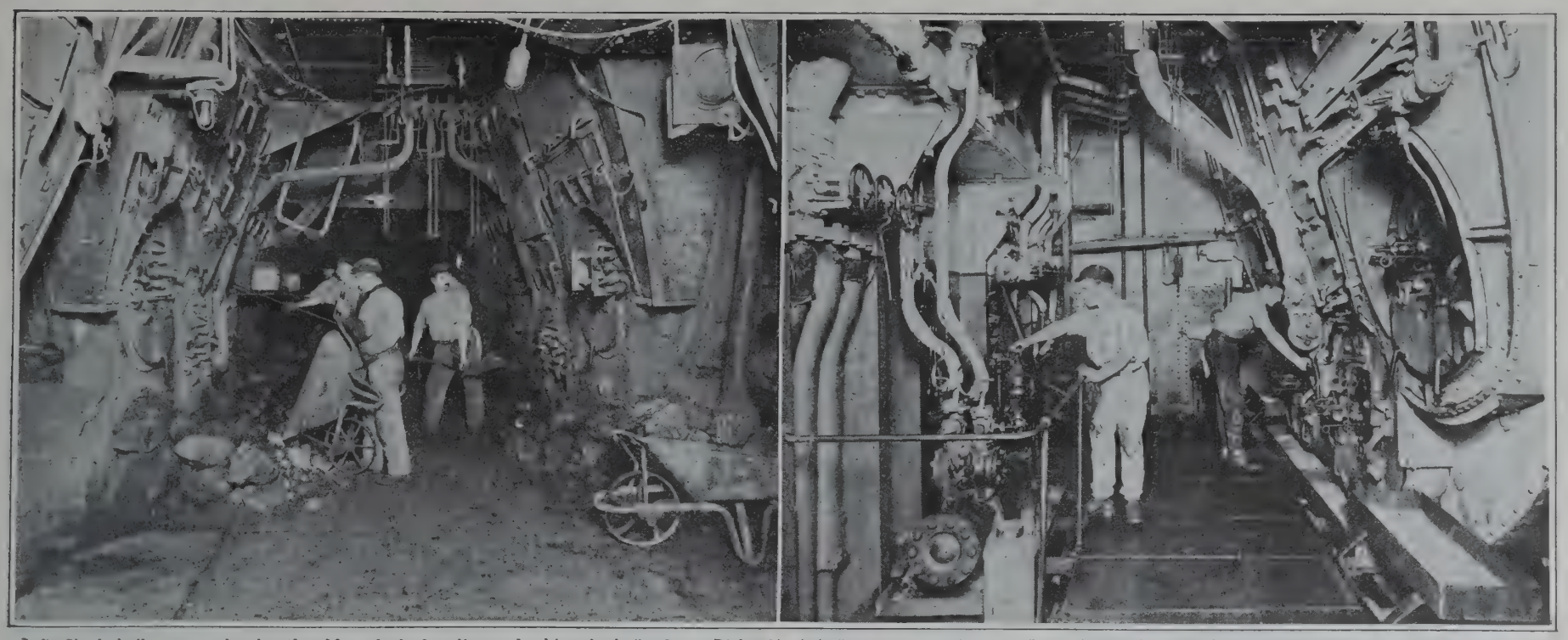
Upper drawing illustrates the manner in which the Lake submergible cargo carrier would break through surface ice for the purpose of making observations and obtaining a fresh supply of air. Lower left-nand sketch shows how the Lake boat would plow her way through rotten ice without resorting to submergence. *P S* are the plowshare-like forward sides of the conning tower designed to turn the ice aside which is first broken by the stout steel rib, *B*. Lower right-hand sketch is a cross-section of the submarine freighter amidships. 1, Non-watertight shelter house. 2, Central control station and buoyancy tube. 3, 3, Passageways and buoyancy tubes. 4, 4, Side buoyancy tubes and oil tanks. Lower central drawings give plan view and outward elevation of the freighter. *A*, Air intake. *B*, Ice-breaking rib. *H, H, H*, Hydroplanes or diving rudders. *K*, Bilge keel. *L, L*, Collapsible life boats. *M, M*, Masts which are lowered to the deck when running submerged. *N, N*, Superstructure. *P, P*, Periscopes. *S*, Elevating steerman's station and air intake which can be lowered level with top of conning tower. *T*, Conning tower. *V, V*, Ventilators. *W*, Wireless.

**The submarine freighter designed by Simon Lake for traversing the Arctic ice fields for the purpose of shortening ocean distances**



*Left:* Single boiler room, showing the old method of coaling and raking the boiler fires. *Right:* Single boiler room with the new oil-burning equipment, showing the oil fuel unit and furnace fronts

**The old and the new boiler rooms aboard the "Aquitania"—an interesting study of the application of oil as a fuel**

## The "Aquitania" as an Oil Burner

### The Advantages in Economy and Operation of Oil Over Coal Firing

THE "Aquitania" was the third of the big liners of 900 feet length and over to be placed upon the Atlantic route prior to the war, the other two being the "Imperator" (1913) and the "Vaterland" (1914) now the "Leviathan." The "Aquitania," 901 feet in length and driven by turbines of 60,000 horse-power, left Liverpool on May 30, 1914, on her maiden voyage, and covered the distance to New York at an average speed of 23.1 knots, the return trip being made at a speed of 23.45 knots. At the outbreak of the war, she was converted into an armed cruiser for patrol duty. She then did duty as a hospital ship and subsequently as a transport in the conveyance of American troops. Subsequently to the armistice she was used in the repatriation of troops, after which she once more took up her regular work as a passenger ship.

At the close of last year she was withdrawn from service and sent to the Armstrong yard for a thorough reconditioning, and for the reconstruction of her bunkers and the installation of the necessary plant to enable her to burn oil fuel in place of coal. After eight months out of service the "Aquitania" recently made her first visit to this port, which she reached on the day when the "Resolute" and the "Shamrock" failed to race because of the rough sea which prevailed off Sandy Hook. The accompanying photograph was taken from the Committee boat while the two yachts were reaching out past the "Aquitania" to the lightship. It serves to show that a rather nasty sea was running.

The change from coal to oil involved the reconstruction of the coal bunkers to enable them to serve as oil tanks. To this end the bulkheads were stiffened and all joints were made oil tight. "Wash" bulkheads were fitted to prevent surging of the oil. The side bunkers extend for 370 feet along each side of the ship in the wake of the boiler rooms, and they are generally 18 feet wide. There are also three large athwartship bunkers. All of these have been converted for oil carrying. Also, six tanks in the double bottom have been similarly converted.

The total capacity of all tanks is 7,800 tons. This is sufficient for a round voyage from New York to Liverpool and back, which means that the oil can all be shipped at New York. The tanks are fitted with steam-heating coils for cold weather, except those athwartship, which receive sufficient heat from the boiler rooms to ensure the proper fluidity of the oil at all times.

The system of burners, etc., is known as the White low pressure, after its inventor, Mr. W. A. White. This is the system used in the new installation on the White Star liner "Olympic," as referred to in a former issue of this journal. In this system the oil is sprayed by pressure, no compressed air being used. To prevent the possibility of a shut down, a duplicate set of pumps and heaters has been provided for each group of boilers.

Along both sides of the ship, for the length of the boiler rooms, there extends an 8-inch suction and filling main, and four connections to the filling pipes are provided on each side of the vessel. The capacity is such that the whole fuel supply of 7,800 tons can be taken aboard in 6 hours from a tanker lying alongside. The value of this in shortening the turn-around of the ship in port will be evident.

From the point of view of the marine engineer, the paramount advantage of oil fuel is the reduction of the boiler room force and the prevention of the loss of steam pressure, which occurs whenever fires have to be cleaned in coal firing. The "Aquitania" has 21 double-ended Scotch boilers with a total of 168 furnaces. It was the practice to clean 28 of these fires

(*Continued on page 166*)

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**The "Aquitania" as she arrived in New York Harbor, completing her first trip as an oil burner**

## What Is an Asphalt Road?

### Some Facts Regarding the Use of This Material for City and Rural Pavements

IT is a surprise to many persons when they realize for the first time how importantly asphalt enters into their daily lives. For instance, the roof of your house is probably asphalt in the form of prepared roofing, asphalt shingles or "gravel" roofing; if your work is in a factory you will find the boilers and smoke stacks coated with asphalt paint, and if it is an up-to-date plant the floors and stairways are probably of asphalt mastic; the wires of your telephone are insulated with asphalt; the swimming tank where you bathe and the reservoir from which your water comes are water-proofed with asphalt; then when you cross the street, your rubber heels, whose toughness is due to the asphalt they contain, come down with the well-known springiness on a smooth asphalt pavement.

A large percentage of the pavements in America are asphalt pavements—and this includes the paved roads in the country as well as asphalt streets in the cities. Only the engineers who design pavements and the contractors who lay them know how difficult it is to construct a pavement that will stand up under the tremendous traffic of today, when loads of fifteen tons are not uncommon. Every imaginable material has been tried—stone, gravel, wood, concrete, brick—but the majority of city pavements laid today are asphalt pavements of the well-known type.

Most persons have a very hazy idea of what an asphalt pavement is. Generally speaking, there are three kinds of asphalt pavements. The one most usually found in cities where the traffic is very heavy is known as sheet asphalt, which, as the name implies, resembles a smooth sheet laid over the roadway. Although it is an "asphalt" pavement, asphalt itself is only a small part of the pavement, though the most important.

The pavement is built by laying first a foundation consisting usually of about six inches of concrete, though a bituminous, an old brick pavement, or an old macadam road makes a good foundation or base. On this foundation the asphalt mixture is laid in two courses; the first, or binder course, consists of a mixture of hot asphalt, sand and broken stone, mixed in a special asphalt plant, hauled to the street, then raked out and rolled with a heavy roller.

(*Continued on page 166*)

# Succeeding in Railway Mechanical Engineering

## A Profession Which Offers Exceptional Opportunities to the Trained Mechanical Engineer

By Raymond Francis Yates

RAILWAY mechanical engineering is a special branch of mechanical engineering necessitating a college training of from four to six years. It is a profession that has a larger following in the United States than in any other country in the world, due to the extent of our railway systems. This means also that there is a greater future for the railway mechanical engineer in this country than in any other. America's wealth has been made possible by her railroads; her future depends largely upon them. The young man entering this field can feel that he is associating himself with a stable profession that will give him any future his ability and capacity justify. It is a field in which big deeds are possible and one in which big deeds are recognized.

The author is enabled to outline the field of railway mechanical engineering through the kind and unselfish assistance of a man who is well known in the field but too modest to be quoted. This man has been in a position to survey this field for a number of years, and what he has had to say regarding it can be taken as good, sound advice. If more young men would heed the advice of successful men in the field they contemplate entering, there would be more successes in life than there are at the present time.

It has been the custom of the writer in the previous articles of this series to outline briefly the importance of each engineering profession to the welfare of the country. There is no profession, of course, that is *the* most important. All of them are important, but some of them are relatively more important than others.

It has been stated previously that the wealth of the country has been largely developed through the agency of the railroads. The prosperity of the country then depends to a very great extent upon the efficiency and economy with which its transportation systems are managed. This, in turn, depends largely upon the railroad mechanical engineers who, in a way, stand guard over the largest and most perfect transportation systems in the world. The railway mechanical engineer renders service of the most valuable nature in improving the design of cars, locomotives, etc., in the general interests of operating efficiency and economy. It is through the honest efforts of these men in the past that we have the most powerful, fastest and most efficient locomotives in the world. Few stories of industrial development and progress have more romance, more daring and more interest in them than that of the railroads of the United States.

*NO field is more fascinating to the average young man than that of railroading. There is a spirit of action abroad in all fields of railroading, whether it be in the running of trains, dispatching, sorting out cars in the yards, repairing the rolling stock, or even in the offices where the entire business of railroading is boiled down to so many figures on the leaves of the ledger. In the present article Mr. Yates has to do with the work and the opportunity of the railway mechanical engineer. Few fields offer greater inducement to the technically trained man than this profession; for after all is said and done, the railroads are the very arteries of any nation and railroading is the one essential work of all time. The present article is one of a remarkably complete series of articles appearing regularly in these columns and having to do with the opportunities in various trades and professions open to ambitious young men.*—THE EDITOR.

What must the training of a successful railway mechanical engineer be? The length of time that an engineer must spend in training varies. In the ordinary case four years of intensive college training will suffice. The length of time that a man should take for education along this line depends to a great extent upon the size of the road with which he expects to follow his profession. If it is a small independent road, probably the four years' training will equip him to master easily all the problems it may present. On the other hand, if he contemplates a more successful career and wishes to become connected with one of the larger railroads of the country, more time must be spent in preparatory work. In fact, some of our better engineers have spent years in training, supplementing their college courses with several years spent in the shop and designing room. A few have made short cuts and have attained their title within a few years; but a man cannot really call himself a thoroughly trained railway mechanical engineer until he has spent some time gaining practical experience in the railway mechanical department. It is here that he gets his first really thorough understanding of the construction and maintenance of the equipment. Although a few of our large colleges are fairly well equipped for the teaching of this profession, none of them is able to construct locomotives, box cars or other rolling stock; experience along this line must be gained with large manufacturers such as the Baldwin Locomotive Works or the American Locomotive Works. It is also possible to gain this experience in some of the good repair shops of the railroads where equipment is being continually overhauled and repaired.

The gentleman interviewed informed the writer that there have been many successful railway mechanical engineers who were self-trained. These men have proved beyond all possible doubt that there is a future for the man who cannot go to college and yet who has a desire to succeed in this particular field. The men in question possessed marked mechanical ability and this was probably their greatest asset. This, combined with the opportunity of associating with engineers and a continuance of home study, secured for these men practically as much technical knowledge as the average college graduate possesses.

The need for mathematics in this profession is about the same as in general mechanical engineering. The problems met are of the same general nature. Of course the study of higher mathematics is necessary, as there is no room for the rule-of-thumb man in this field. Too much depends upon a locomotive to have the design of its parts decided upon without calculation of the most accurate nature. If the connecting rod or crank pin of a locomotive traveling at high speed breaks a catastrophe generally follows in which many lives may be lost; and every railway mechanical engineer must feel the responsibility that rests with him. The writer mentions mathematics only for the benefit of the man who has decided upon training himself as he usually looks upon this as the most difficult thing he has to accomplish.

One of the most necessary qualifications for a young man entering this special field of engineering is natural engineering ability and initiative. It is not exactly a vocation for the admirer of "white shirt professions." A man entering this field has to be a worker, one who is not afraid to dirty his hands and get mussed up out in the shop, as this is all part of the training. A locomotive is not a clean thing to play around, and during the shop experience of the engineer a certain amount of this work is essential. Second in importance to natural engineering ability, a young man must have a fair supply of determination. Of course determination is necessary for success in any field but not of this particular brand. A man must have determination in this field in order to get "those high up" to adopt his recommendations. This requires faith and no little perseverance.

The salary of a railway mechanical engineer is a difficult thing to state definitely. It depends upon the size of the railroad. Of course the larger roads have more money, require greater talent and are willing to pay for it. About the best salaries that are being paid at this time are in the neighborhood of $6,000 per year. They range anywhere from $2,000 to this figure. Of course, the writer does not mean to infer that $6,000 is the absolute limit for a man of exceptional ability. The American Association of Engineers recently made some very definite recommendations regarding the salaries which mechanical engineers of this type should be paid.

A word about the future of railway mechanical engineering. Of course this depends entirely upon the development and progress of our transportation systems and one who realizes how this has gone forward in the past need have no concern about its future. The railroads of this country simply have to keep growing. There is a very good future for this profession as the increasing costs will make it necessary to incorporate greater refinement in locomotive and car design. This will create a demand for men who are capable of a higher quality of engineering work than was thought necessary in the past. In other words, during the past the railroads were not so much concerned with minute details of efficiency as they will be in the future. This makes the field more promising for the man with extraordinary ability and unusual training. It will call for the best there is in men with higher engineering talent.

Very few, if any, railway mechanical engineers go into business for themselves even in a consulting practice. In fact they would not have many people to consult them as the big railroads have engineers of their own and do not find it necessary to go outside of their own organization for advice. Most engineers consider that their first connection with a railroad is only a stepping stone to something higher up. There are many positions on a railroad for which an engineer may qualify. There is the position of mechanical superintendent, superintendent of motive power and other good and remunerative positions in the operating department.

With the great importance and extent of our railroad systems in this country the reader will probably be surprised to learn that only two or three of our colleges offer really worth while special courses in railway mechanical engineering. In general these courses are about as satisfactory as most of the other engineering courses. This is not saying that they are perfect by any means, and probably the next few years will see a marked improvement in the training offered along this line.

What course should the young man follow who desires to become a mechanical engineer and who cannot enter college? In general it can be said that there is a fair chance for any young man to become a self-trained railway mechanical engineer. There is probably more chance in this field than in most technical professions.

First, a position should be obtained in a railway repair shop or in the shops of one of the large American locomotive manufacturers. This work will bring a man into daily contact with locomotives of all types and he can see them being taken apart, repaired and assembled. If he uses his eyes, his head and a note book the most valuable part of his education can be obtained in this manner. Aside from this, a study of general mechanical engineering should be followed. This can be followed as a night course in a local school or as a correspondence course. There is still hope for a man unable to take up either one of these courses. Intensive study of the subject will eventually bring success although it will require a greater length of time.

## Utilitarian Fruit Wrappers

THE fruit wrapper, first used in Pacific coast fruit industries, for many years had a prejudice to live down in the East. The East still typically sends apples to market unwrapped. The Eastern idea has always been that wrappers for fruit were a superfluous luxury, and though the Western wrappers are now taken as a matter of course, it being apparent that they are an established thing, there is still little appreciation of their utilitarian value.

Any fruit wrapper tends to prevent decay, as the individually-wrapped orange, pear, apple or lemon has a measure of protection from outside. As the wrapper has come into extensive use, moreover, there has been great improvement in wrappers.

The consuming public little realizes it, but much of the high class Pacific coast fruit it eats is prevented from decaying in transit by chemical agents in the fruit wrapper used. Not any paper will do for a wrapper, but a special fiber wrapper chemically treated to do quick, efficient work when the fruit is bruised. Decomposition, as is generally known, starts with a bruise. The effect of the special wrapper is to cling close, dry up the escaping juice, harden the spot and kill bacteria.

Fruit wrappers are doing this thing daily, not occasionally but in innumerable cases. The economic loss averted is enormous. Fruit wrappers are not a commentary on a civilization given to super-refinements of luxury, but to a race careful to stop the small leaks.

# Electrification in Brazil

## How the Sao Paulo Railroad Is Following the Example of Its American Namesake

By Robert Carlton Brown

THE recent announcement of the forthcoming electrification of a portion of the lines of the Paulista Railway in the State of Sao Paulo, Brazil, has aroused great interest in railway and electrical circles of South America, the United States and Europe. The electrification was decided upon only after the company had made an exhaustive investigation of its possibilities. Simultaneously with the announcement of the letting of the contract, work on the manufacture of equipment for the great enterprise was begun in the United States.

The initial enterprise on the Paulista Railway will extend over a line forty-four kilometers in length from Jundiahy, the southern terminus of the Paulista Railway, northward to Campinas. The railway is double-tracked over the whole of this distance.

This installation calls for twelve electric locomotives, eight locomotives for freight service and four locomotives for passenger service. The freight locomotives will weigh ninety metric tons each and the passenger locomotives 110. These locomotives will be operated at a tension of 3,000 volts of direct current. They will take their power from two overhead copper trolley wires by means of a pantograph operated by compressed air. These locomotives will each contain four motors connected with the locomotive driving axles by means of double-spring gears and pinions. The locomotives can be controlled by one man with the ease that a street car is operated.

Electric power will be furnished to the railway by the Sao Paulo City power company, which will deliver three-phase, sixty-cycle power at 88,000 volts. It will be distributed along the lines of the Paulista Railway for connection at the various power substations which will be eventually installed. For the operation of the electric locomotives over the initial section, a power substation will be installed midway between Jundiahy and Campinas.

This substation will convert the 88,000-volt alternating current into the 3,000-volt direct current for delivery to the overhead trolley wires. The equipment for this substation, which will have a total capacity of 4,500 kilowatts, will include a system of three motor-generator sets of a capacity of 1,500 kilowatts each. These will consist of 2,300-volt, three-phase, synchronous motors, directly connected to two 1,500-volt generators. These will operate in series and will give the potential strength of 3,000 volts required to operate the locomotives on the line.

There also will be included with each motor-generator set, and mounted on the same shaft with the motors, an exciter which will provide excitation for the two generators. The 88,000-volt current which enters the substation is stepped down to 2,300 volts for connection to the motors by means of transformers. A switchboard with automatic switching equipment and meters also will be provided for measuring the current which enters the station as well as that which is delivered to the trolley system. These automatic switches will be so designed as to provide the maximum protection to all apparatus as well as to the operators against any possible accidents. The lines will be further protected against lightning by means of electrolytic lightning arresters. The trolley wires will be supported by means of the well-known catenary type of overhead suspension, especially developed for high voltage, heavy traffic and high speed service. The steel rails used for the present system of steam locomotive service will be connected by means of copper bonds to establish the return circuit.

Materials for the new work will begin to arrive in Brazil from the United States within a few months and the railway company will immediately begin work on the electrification, assisted by engineers of the electric company. The installation of the power transmission lines and the overhead trolley system will be started first. Work will also be started at once on the first substation and it will be ready to receive the machinery on its arrival. The huge locomotives will be the last of the equipment to arrive. These will be unloaded at the port of Santos. They will be assembled there and will proceed to Jundiahy over the rails of the Sao Paulo Railway. It is expected that the electrified system will be in complete operation by July, 1921.

One feature of the electrification will be that the direct system of current will be used instead of the usual alternating current. The locomotives to be used will be provided with the regenerative braking system, whereby the locomotives and the trains when descending a grade generate power which is returned to the line. The speed of trains descending grade can be very accurately controlled by this system and at the same time power is being generated. Further advantages of this system include elimination of difficulties incident to the use of the airbrakes on heavy freight trains when descending grades; elimination of brake-shoe and wheel wear with resultant reduction in maintenance; reduced wear on tracks, especially on severe curves; and entire absence of grinding of the brakes which is especially disagreeable on a heavy passenger train.

Economy is the big factor in favor of electrification of railways, although there are many other arguments to be advanced in favor of the replacement of steam locomotives by the electrical equipment. The high cost of coal has always been a leading item in the expenses of the railways of Brazil and it is believed by many observers that the coal question will eventually result in the electrification of most of the railway systems of the republic. Electrification is peculiarly practical in Brazil in view of the great abundance of waterfalls. Excellent waterpower is easily available to a large portion of the railway area of the country.

Experts of the electric company who are in Brazil on the Paulista enterprise summarize the advantages of electrification under two leading heads. One of these

(Continued on page 166)

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### Seeing in the Dark

To the Editor of the SCIENTIFIC AMERICAN:

In the article, "Detecting Men by Their Heat Radiation," in your issue of March 27, 1920, it is stated that my instrument "can detect the difference between the painted and unpainted sides of a steel plate, of which the temperature is slightly higher than the surrounding atmosphere."

The interesting fact is that on *clear nights* the instrument readily detected the difference between the painted and unpainted sides of an invisible steel plate which had the *same* temperature as the surrounding atmosphere. And, furthermore, the side of the plate which was painted black gave an indication similar to that which would have been given by a body considerably warmer than the atmosphere, although there was no question of the fact that the entire plate was at the same temperature as the surrounding atmosphere. This result was in direct contradiction to what had been predicted from previous laboratory tests on a *cold* body, in which the blackened metal gave a considerably *colder* indication than that given by the unblackened part (both parts being of course at the same temperature). An analysis of these laboratory results led to the conclusion that the large cold indication of the blackened surface was, of course, a measure of the true temperature of the metal, while the warmer indication of the bright metal was caused by reflected energy from the walls of the apparatus which were at the higher temperature of the room. This unexpected result seemed entirely to negative my method and I took care that news of it did not get to Washington until I had made some actual field trials. Many authorities held that the radiation from objects such as men would be entirely obscured by the effect of the surrounding atmosphere and the background, and this laboratory test was held to support their view. However field tests showed that I was right and they were wrong, and resulted ultimately in the very successful results alluded to in your article.

I might add that the reason for the cold indication of the bright metal when in the open, on clear nights, was reflection of the intense cold of interstellar space, or stated more correctly, a cooling of the blackened surface of the thermopile by radiation into space. It was this fact that rendered it so easy to detect aircraft on clear nights, as the plane, coming between the instrument and the outer sky, acted as a shutter to stop this radiation into space, and resulted in giving a large warm indication.

San Francisco, Cal. SAMUEL O. HOFFMAN.

### Cleaning the Clock

To the Editor of the SCIENTIFIC AMERICAN:

As a reader of your publication for more than thirty years, twenty or more of which have been spent in the repairing of all kinds of time-pieces, I wish to protest against the printing of such ideas as those contained in a recent article on the use of kerosene as a cure for dirty clocks.

The oil used on clocks is as near non-drying as is obtainable but even the best will dry up somewhat after the long time between cleanings. As there is less than two drops on the whole outfit of pivots in the ordinary type of clock it can be easily seen that the supply is small and not renewed from oil-cups as in many other types of machine. Also the clock is more or less open to the air around it which has a great deal of dust floating in it ready to stick to anything fluid like the oil around the pivots. This tends to thicken the oil and to work into pivot-holes, serving as an abrasive to cut the pivots.

The only way to relieve the condition is to take the clock completely to pieces and clean each and every piece; to "peg out" each hole; polish the cut or worn parts and then to assemble the whole for proper oiling on clean metal.

The use of kerosene on a tuft of cotton is as much good in the manner given in your article as it would be in removing carbon from the cylinder of an automobile by placing a cloth wet with the "panacea" on the floor of the garage under the machine.

Newton Center, Mass. F. W. WOOLWAY.

### Measuring the Flow of Liquids

To the Editor of the SCIENTIFIC AMERICAN:

In the June 19th issue of the SCIENTIFIC AMERICAN we notice a description of instruments for measuring and recording the flow of liquids, recently brought out by a large British firm.

The description is so exact that we have no difficulty in recognizing this as the device originated by Mr. Lea, mechanical engineer of Manchester, and the only reason of our writing to you is because of the inaccuracy of the statement that this has been recently brought out.

As a matter of fact our clients have been the American manufacturers of this instrument on which they hold several patents on improvements since 1911. We know that several thousand of these are in use in many of the largest plants in this country, Great Britain and other parts of the world.

The device is not new but is a well-established and time-tested device.

Philadelphia, Pa. R. G. E. ULLMAN.

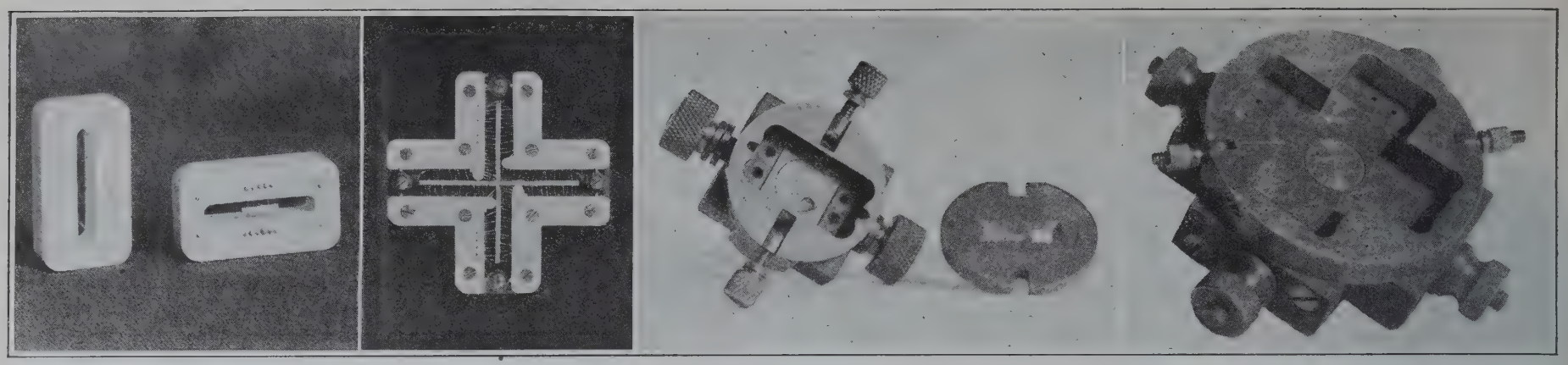
### Invention vs. Re-invention

To the Editor of the SCIENTIFIC AMERICAN:

Your article, "A Boat That Pumps Its Way Along," in the issue of the SCIENTIFIC AMERICAN of June 12 and the illustration of the same is certainly another proof, as you say, that "history is forever repeating itself." The principle involved in the propulsion of this boat is identical with that James Rumsey used about twenty years before the "Clermont" went up the Hudson. Of course he had none of the fine mechanism of modern times, but the boat was propelled by taking in water near the front of the boat and expelling it in the rear. Undoubtedly this was the first application of steam to navigation. Recently the state of West Virginia has erected a beautiful monument overlooking the point in the Potomac River at Shepherdstown, West Virginia, where the first demonstration was made by Rumsey December 3, 1787. No one will claim that the old "Constitution" is anything to compare with the modern dreadnought, and, of course, Rumsey's crude beginning is in the widest contrast between the modern floating palace, but honor to whom honor is due.

THOS. C. MILLER.

Shepherdstown State Normal School.



1. Thermopile used for trench purposes, one-half actual size. 2. The "cross-hair" thermopile used in the aircraft detector, about one-half size. Note the elaborate construction. 3. Heavy metal holder for the trench thermopile. 4. The massive holder for the "cross-hair" thermopile.

**Thermopiles and holders for trench purposes and for detecting airplanes in the dark**

# Seeing in the Dark

## An Account of the Success Obtained During the War in Detecting Invisible Objects by Their Bodily Heat

By Samuel O. Hoffman, formerly of the Science and Research Division, United States Army

WHEN in the early years of the war the horrible nightly Zeppelin raids commenced, attention of engineers all over the world was directed toward finding a means of combating this menace. The time of occurrence of these raids, always at night, suggested the solution of the problem. Remove the enshrouding darkness and the raiders would fall easy prey to artillery fire and the fast combat planes. As the war went on and degenerated into the deadlock of trench fighting a much greater need arose for the same device. Trench warfare was almost entirely a matter of night activity. Scouting and patroling, raiding, wiring, and other work was done almost entirely under cover of darkness. Although at night the front was a beehive of activity, any circulation in daylight, even far in the rear, quickly drew enemy fire.

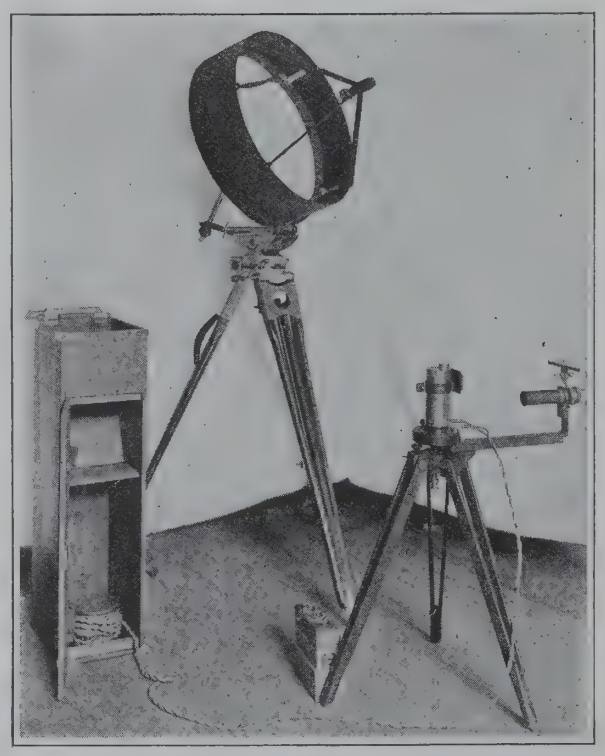
It can be thus seen that an urgent need arose for nothing less than a *sixth sense*, a means of seeing in the dark. It is apparent that if either side had had such a device they would have had a preponderating advantage, and, at the very least, trench warfare would have been profoundly modified. Curiously enough, results have shown that such a device *is* practicable, and it was in fact subsequently worked out, although too late to be used in trench warfare.

The question will be asked, Did not flares and star shells supply this need? Emphatically not. In the first place, they were equally available to either side. They gave only intermittent illumination; and the enemy, caught in the glare of a star shell, knew he was under observation and by remaining motionless could escape detection. Moreover, these methods were useless for detecting aircraft at night.

For a number of years prior to 1915, the writer had devoted the greater part of his time to investigations involving infra-red radiation, and his familiarity in this field immediately suggested that here was the solution of the problem. This radiation is the ordinary dark heat such as is felt on bringing the cold hand an inch or so in front of the face. While of the same general nature as light, it has quite different properties. Hardly any substances are transparent to it, rocksalt being the only one easily obtainable. Glass is particularly opaque, so that ordinary optical instruments are useless. However, sharp images can be easily formed by using concave mirrors of ordinary dimensions, as the actual wave length of this radiation is sufficiently small (1/2500 inch) to obviate trouble from diffraction. This is the reason for the great superiority of this radiation over sound waves for detecting purposes in the dark, for with any available sound waves (in air) it is possible to form a sharp image only with monstrously large apparatus.

By the middle of 1915 the problem was pretty well formulated, the amount of energy available was calculated, and it seemed certain that the whole idea was practicable. Attempts were made to interest several branches of our own War Department, the British War Office, Admiralty and Inventions Board, and several other agencies. Almost everywhere the idea received attention and courteous replies—and nothing more. Ideas were at a discount. What was wanted was developed apparatus.

A year or so went by and the early part of 1918 found the author in New York with two weeks' unofficial permission to show what could be done. It was easily demonstrated experimentally that there was a large amount of dark radiation available, and that the detection of this radiation would not require very delicate instruments. These experiments were made indoors with a warm body, and as an afterthought the device was tried with a cold body, with apparently contradictory results, for the indicating instrument moved in the opposite direction to that expected. A quick analysis showed the reason for this to be reflection from the walls of the room, and it seemed that this fact would render the device inoperative in the field. The apparatus was hurriedly reconstructed, and



The complete instrument for detecting men in the dark, set up for use. The large tripod carries a 24-inch parabolic mirror, with the thermopile in focus. The small tripod holds the indicating galvanometer

**Complete outfit for enabling soldiers to detect the enemy in pitch blackness**

the following night a test was made on the roof of the laboratory. The result was a complete vindication. Every object sighted on gave a definite indication, some being several hundred feet away. These results were of more value as the mirror used was only 4 inches in diameter, the largest that could be found in New York. Shortly after this roof test official permission was given to continue the work.

The apparatus used in these tests was as follows: A concave mirror was used to concentrate the infra-red radiation on the blackened surface of a thermopile, which consisted of minute wires of bismuth and silver soldered together. The radiation concentrated on this blackened junction was absorbed, heating it slightly. The resulting electric current, flowing through a galvanometer, indicated when the apparatus had spotted something warm. It can be seen that this apparatus was very simple, extremely rugged and portable. Aside from some dry cells to operate the galvanometer lamp, no source of power was required. A potentiometer was necessary to make the device practicable, as it usually happened that the background was a different temperature from the surface of the thermopile, and it was necessary to compensate for this.

During the next few weeks trials were made almost nightly with all sorts of backgrounds and weather conditions. The results were uniformly successful. Men could be detected with startling ease when 600 feet away. The effect on the apparatus was the same whether they were crawling slowly or running rapidly. To simulate a sentry looking out over No Man's Land, a soldier lay in a depression in the ground and lifted his head from time to time. He was detected unfailingly as soon as his head appeared above ground, although at a distance of 400 feet and absolutely invisible to the eye. The murderous possibilities of such a device attached as a sight to a machine gun and trained on men in the dark can be imagined. Ranging the instrument in front of and parallel to our front line would constitute an arrangement for preventing raiders from creeping into our lines undetected.

A report of these results was immediately sent overseas, and, anticipating a favorable reply, the standardization and construction of the apparatus was rushed. Navy searchlight mirrors were used, cut down to two-thirds of their original diameter, thereby obtaining a good optical figure. The mirrors were silvered on the surface, and though they tarnished rapidly, this did not seem to affect the sensitivity and rendered the mirror less conspicuous in the glare of a searchlight. The design and construction of the thermopiles took several months. There was no bismuth wire available in this country, the product formerly coming from Germany. The making of this was immediately attempted, and pliable wire about the diameter of a human hair was successfully produced. About 40 different designs of thermopiles were tried out before a satisfactory design was obtained. This work, all done by enlisted men in the Army, was very tedious. It was necessary to work under a binocular microscope, using special tools. It is interesting to note that no thermopiles of the final design have ever broken in use. So sensitive were these thermopiles to changes in temperature that it was necessary to shield them very carefully from drafts and sudden temperature changes. The enclosing case was made of very heavy metal, the radiation entering through a narrow slit which was covered with a plate of polished rocksalt. The rocksalt had a slight coating of varnish to protect it from the moisture in the atmosphere. Special galvanometers were constructed, and the whole apparatus was extremely compact and self-contained.

About the time this work was finished, a cable arrived from general headquarters of the A. E. F. asking for immediate shipment of the device for test at the front. It went overseas in August, 1918.

So far particular attention had been given to the use of the device in trench warfare. By this time,

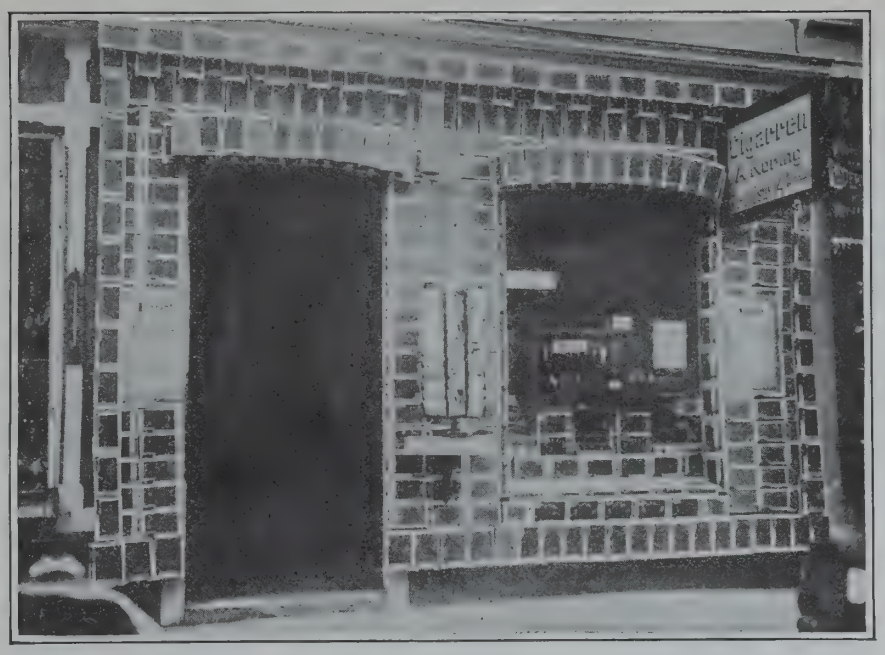
(*Continued on page 166*)

### A Store Front of Cigar Boxes

IT is peculiar to study the impressions that persist year after year regarding various peoples, and that are never revised despite the ever-growing evidence that such impressions are erroneous. For instance, and this is the case in point: The Germans have the reputation abroad of being anything but original and inventive. We regard them as a very thorough and painstaking people, ready to adopt and improve upon any idea which they come across, but not as originators. However that may be, there is daily proof to the effect that the Germans are highly imaginative and original in their own way.

Perhaps it is an aftermath of the war, but at any rate the Germans have been displaying unusual ideas in the field of advertising and publicity of late. Recent expositions in Germany have brought forth almost no end of ingenious publicity "stunts," proving once and for all that the Germans are creative along certain lines.

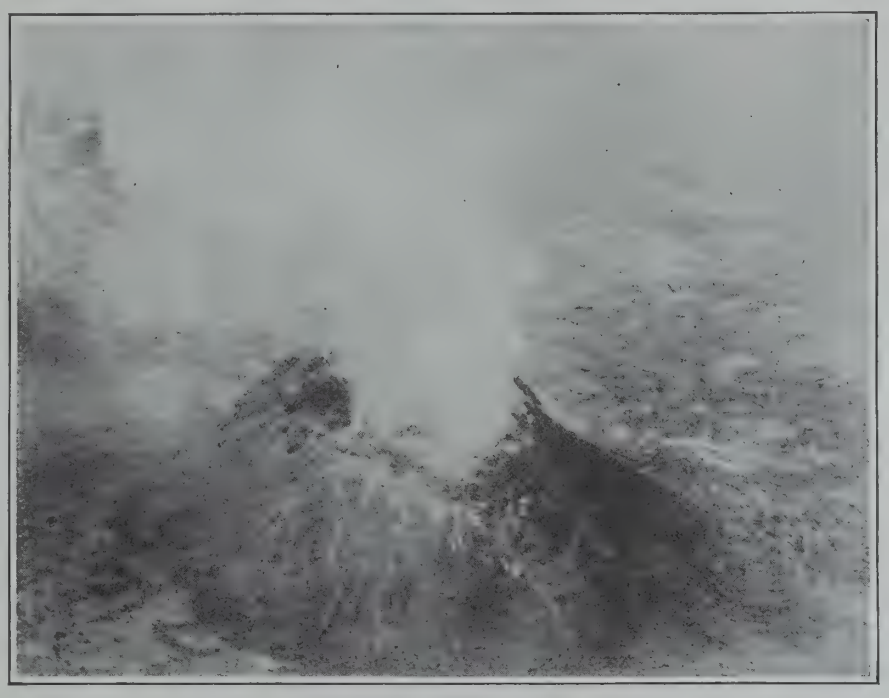
The accompanying view offers an example of this German ingenuity. Here is the store front of a cigar dealer who, finding business somewhat slow, went to work and built a front out of cigar boxes. This store, situated in Bremen, never fails to attract attention from passers-by.



**This Bremen store front covered with cigar boxes never fails to attract the attention of passers-by**

### A Close-Up of Vesuvius

THE accompanying view of the crater of Vesuvius is due to the risk taken by an American Red Cross worker in Italy. It was taken from a point close above the molten lake of lava surrounding the inner cone of the famous volcano. Every few minutes showers of lava and huge stones were ejected from the cone crater, but through good fortune the photographer escaped unharmed.



**A close-up of Vesuvius made by an American Red Cross worker in Italy, at a considerable risk to himself from the showers of lava and huge stones**

### To Make Asparagus Keep

CUT asparagus exposed to drying winds in the open air will become unmarketable in 48 hours, and of poor quality in considerably less than that time. Cut asparagus handled by a person who knows how—any boy or girl can turn the trick—will keep in marketable condition for 12 days. What is more, it will have gained 50 per cent in weight!

Sounds improbable, doesn't it? But it isn't, having been demonstrated in recent experiments at the Oregon agricultural college. The demonstrations should prove of tremendous benefit to family households, to gardeners, and to retail stores.

There are several ways of handling cut asparagus, of varying degrees of efficiency. Exposure to dry air is the least desirable way; a better way is to place in a moist chamber. In a glass case free from a direct air current, asparagus will not wilt though kept 12 days, and will not lose either weight or length. Asparagus stalks, the butts of which are placed in water, placed in the open air, will keep in good marketable condition for 12 days and will increase somewhat in weight.

### The Latest Portrait of the Largest Lady in the Land

WHAT is the accompanying photograph? At first glance it might mean almost anything from a little known variety of shell fish to a new kind of harvester. Even a seasoned New Yorker would not recognize this latest portrait of Miss Liberty—the largest lady in the land.

In order to secure this unusual view of the Statue of Liberty an intrepid photographer climbed out on the torch of the statue and took a photograph looking down on the head. The result is exceptionally striking, and serves to convey an excellent idea of the magnitude of this statue which was brought to this country from France in sections and assembled on its pedestal in New York Harbor. The inside head measurement from ear to ear is exactly ten feet.

Copyright, Kadel & Herbert

**Looking down on the head of the Statue of Liberty from the torch—a very unusual view of this well-known structure**

### Facts About Chinese Eggs

THE standard egg case used in the United States and Canada holds 30 dozen eggs. It is an oblong box, divided into compartments by a partition on either side of which 15 dozen eggs are placed, three dozen to a layer. Between the layers, and between eggs in a layer, cardboard forms an individual safe box for each egg. A cardboard device called the "filler" is universally used.

The standard egg case in China is a two-compartment box in which kerosene, two 5-gallon cans to the box, arrives in the country. The Chinese thriftily reship it filled with eggs. Its capacity is 280, 300, or 360 eggs, according as the eggs are of large, medium or small size. If the eggs are small, the net contents equal those of an American egg case.

The Chinese do not use cardboard "fillers." Instead they use rice hulls, wheat bran, kaoliang bran, or sawdust, and they pack the eggs in regular layers, with skillful distribution of the sawdust or other filling material to prevent breaking. The method is successful. When rice hulls are used, the cost is estimated at about five cents per case.

Facts about Chinese eggs should arouse in Americans at this time much more than a polite interest—for we have been eating Chinese eggs, and Chinese egg products. During five or six years past, large quantities have been exported to this country and Canada, and marketed in large cities. The Pacific Coast is actually worried about the situation, fearing its detrimental effect on the local egg industry. Egg marks acts especially aimed at the Chinese egg, to prevent its being marketed under any deceptive alias, are now operative both in Canada and this country. Chinese eggs can be marketed at a very low price.

The market value of eggs in one Chinese province, Shantung, has risen to such an extent that an estimated three-fourths of the total "lay" is sold by producers. There are 1,500,000 hens in this province, and the average production is 84 eggs per hen. As average production goes, that figure is not low. It has been calculated by Department of Agriculture experts in this country that the average American hen produces little, if any, in excess of 90 eggs per annum. During the past two years, local egg prices have doubled in price in many parts of China, consequent on the export demand, and not long ago quotations reached the dizzy height (for the Orient) of one cent each.

Consumers and poultrymen in this country are naturally most interested in China as an exporter of fresh and preserved eggs. Yet various egg products the ordinary lay reader never heard of account for a much larger percentage of the Chinese production. These egg products are whole-egg powder, dried albumen, liquid yolk, and dried yolk. The exports of yolk in a normal year are calculated to account for over 700,000,000 eggs.

Dried albumen is put up in tins holding 100 lbs. Liquid egg yolk is shipped in barrels holding 430 lbs. net. In addition, large quantities of frozen eggs are exported. These egg products are used considerably in the baking trade.

Why were not Chinese eggs talked of before now? The reason lies in a simple economic condition. It is only within recent years that the level of egg prices in this country has reached so high that financial interests cared to undertake the costs and risk of egg collection in China, shipment thousands of miles to North America, and final sale in this country. The margin existing was not sufficient. With American eggs selling at high prices, however, the situation naturally appealed to the speculator, whose activities have caused such a stir in Pacific Coast egg circles.

# Pulp Wood from Labrador

## A Paper-Supply Likelihood of the Near Future

By J. T. Rowland

TO a person who is familiar with the northern extension of our Atlantic coast which goes by the name of Labrador, it is always amazing to discover the misconceptions concerning that region, which exist, almost without exception, in the minds even of educated and otherwise well-informed persons. The words "lonely," "remote," "desolate" seem to picture the qualities which the mention of Labrador unfailingly calls to mind, while the association with icebergs and an occasional seal imply an immediate juxtaposition to the North Pole. It follows, therefore, that one is usually met with an incredulous smile when he states the fact that Labrador lies between almost exactly the same parallels of latitude on this side of the Atlantic which the British Isles occupy on the other, and that for all the ignorance which exists concerning it, the coast is literally just around the corner from us—much nearer the northeastern extremity of the United States than Alaska is the northwestern.

**Why the coast of Labrador stays cold: One of the many icebergs to be found in the coastal waters**

The reason for our lack of knowledge—and interest—is neither the remoteness nor the Arctic aspect of the land, but the simple fact that it produces nothing which we have heretofore thought worth the trouble of going to fetch. "A few poor cod and worse pelts," as one mission doctor summed it up, have made the total of Labrador's contribution to the world's wealth. For this reason the coast has languished in disregard. Poorly chartered, unbuoyed and next to unlighted, with many of its hundreds of bays and inlets actually unexplored and the position of islands and reefs known only to unlettered fisher folk, it is small wonder that the great ships bound out from Montreal pass the coast by with a shudder and are thankful each trip when the Strait of Belle Isle has been left astern.

Some years ago I was discussing with Dr. Grenfell the possibility of Labrador's some day becoming economically useful to the world. We stood on the summit of a hill of rock overlooking beautiful Grosswater Bay, which I could see, in my mind's eye, sheltering a fleet of a thousand ships. "There is nothing in the world to keep people away," the doctor was saying, "except only the fact that there is nothing to bring them. If ever that is changed we shall be swamped!" To the medical missionary who had devoted his life to the people of the coast such a prospect had much in it which was naturally not pleasing; but whether or not Labrador needs the world, the day has come when the world needs Labrador—and what it needs it generally takes.

Climatically Labrador is divided into two regions, the coast and the interior. The former is a few miles wide and is Arctic in character, the latter is a few hundred miles wide and is what one would expect to find in the fifties of north latitude; that is to say, it is well watered, densely forested and quite similar in character to the North Woods—hot in summer and cold in winter. This amazing disparity in climate between two regions so close together is due entirely to the fact that the polar current, setting southward out of Davis Strait, prevents the seaboard from ever growing warm. There is floe ice along shore until late in the spring and there are bergs, though not in sufficient numbers to be a serious menace to navigation, all summer long; and the temperature of the sea water rarely gets far above 32 degrees. Thus, it is the Arctic condition of the coast which is abnormal, if one may use that word of an established natural condition, and it is the north temperate climate and flora of the great interior which is "normal" and as it should be; but the sea coast's forbidding aspect has so long been synonymous for Labrador that it is hard for any one to believe that there can be anything but barren tundra behind.

I shall never forget my own surprise at my first glimpse of the hinterland. We had been for days skirting the coast in one of Dr. Grenfell's hospital launches and had seen nothing but ice and bare rock—not a bush or a blade of grass. At last we swung west around a great headland and started threading our way up a narrow defile between immense hills of a blackish rock. After about a half hour's steaming we came upon a little clump of dwarfed tamarack nestling in a hollow. Then suddenly the vessel turned a sharp corner and we came out abruptly upon the waters of a beautiful big lake, surrounded by gently rolling hills covered to the water's edge by a forest of spruce and tamarack so dense that one could see scarcely ten feet back into it. The air here was warm and the sky overhead blue; we felt as though transported back by some magic to the shores of an Adirondack lake. Yet this was all deep water, easily navigable by the largest ship. Perhaps half a dozen white men at most had ever seen it before us.

This description will fit, with modifications as to distance, the head of almost any one of a nearly innumerable series of inlets and fjords, for the coast is very much indented and looks on the chart almost like the fringe of a rug. Hamilton Inlet penetrates the farthest—nearly 150 miles straight back from a line drawn across the outlying headlands—and its inner half, Lake Nelville, is a veritable inland sea of about the size and shape of Long Island Sound. When I last visited this water its shores were strewn with quantities of saw logs from a raft which had broken up in a storm. This was the aftermath of the efforts of a half-baked Nova Scotia concern. It lacked the equipment to collect the logs, and it did not long survive their loss.

More recently, however, the knowledge that there is behind that forbidding, desolate coast an almost limitless supply of readily accessible wood has begun to attract interest for purposes other than lumbering. Pulp wood is every year more greatly in demand and more difficult to secure. Moreover, timber which is not sufficiently tall or heavy for profitable lumbering is commercially valuable for pulp wood. In many cases this has resulted in denuding forests of their young growth. Labrador is probably the one place on earth where this would do no harm, unless it be to an occasional spruce hen. The country is singularly devoid of game.

The timber consists chiefly, almost entirely in fact, of spruce (*Picea nigra*) and tamarack (*Larix americana*). In size it runs from a few inches to two feet in diameter at the butt. The farther inland one penetrates the larger the timber grows, but my personal observation has been that two feet is about the limit, except for occasional trees. It grows most abundantly around the heads of inlets and along stream courses. The higher hills are bare, as are likewise considerable stretches of elevated plateau.

Roughly speaking, the northern limit of the timber is in about 57 degrees north latitude. At least I have seen none to the northward of this at a distance some fifteen or twenty miles back from the coast, though at Davis Inlet in 55° 50′ it is abundant. This means that there is a belt of timberland some 400 miles long, north and south, which is immediately accessible by navigable waterways to an average depth of perhaps 30 miles, without counting the great interior basin of Hamilton Inlet. The timber is suitable for pulp wood and is of little or no value for any other purpose.

A pulp wood enterprise has already been undertaken upon the Alexis River, on the southern portion of the coast, not far from Dr. Grenfell's hospital and mission post at Battle Harbor. Others will doubtless follow and it may be that the inundation of the "lonely Labrador" by foreign workers is just around the corner of the future if given adequate means and knowledge.

Photographs Courtesy *Motor Boating*

**A bold promontory near Cape Mugford. The peak is 3,000 feet high**

**Entrance to Battle Harbor, with fish merchants' rooms in whitewashed buildings**

*Left:* Side delivery rake. Even where horses are used, modern farm implements make work easier for the farmer. *Right:* An eight-fork hay tedder

## Harvesting the Hay the Latest Way

By Arthur L. Dahl

THE United States is about to harvest the greatest crop of hay ever produced, estimated at 111 million tons. Lack of farm labor is largely responsible for the record crop, for areas that would ordinarily have been devoted to the growing of food crops were allowed to raise volunteer crops of hay because labor was not available to work the land. The labor shortage is just as acute in this harvest period and the quality of the hay produced will be largely dependent upon the efficiency with which the gigantic crop is gathered and prepared.

Hay making is an operation that must be done in a certain space of time that is short at best and that is always liable to be made shorter by bad weather. For this reason there is perhaps no farm operation in which system and efficiency count for more than in haymaking. Hay has been quite steadily increasing in acreage for a number of years, until at the present time it occupies about one-sixth of the tilled area on farms in the United States, and has an annual value on the farm, unbaled, of over a billion dollars. It has been estimated that the annual cost of harvesting our hay crop, under normal conditions, is about $125,000,000. When we contemplate this enormous amount of money it is easy to see that a reduction of even a small per cent of this cost would add millions to the profits of the hay growers of this country, and according to experts of the Department of Agriculture it is possible for every such grower to make substantial savings by using proper equipment. As a single example of the efficiency of proper implements, it has been demonstrated that one man with a team can turn more hay with a tedder than can 12 men doing the work by hand. In a period of labor shortage and high wages the use of haymaking implements is not only economical but almost necessary.

Hay is the bulkiest crop grown on our farms, and its cutting, curing and stacking require a great deal of power. Efficiency in haymaking, therefore, turns on the utilization of the cheapest and most abundant power. On the average farm tractor or animal power is available in abundance, even though manpower is short. Wasted human labor does not always mean idleness but more often labor expended unnecessarily on operations which are not efficiently planned and carried out.

The first operation in harvesting hay is that of mowing. Here there are a number of factors that make for efficiency and saving. The time of day when the mower is started has a direct bearing on the amount of hay made per day, and the arrangement of the moving crews likewise affects the results. The size of the mower used has a decided bearing on the quantity cut in a day, and other factors enter into the proposition.

On a great many farms the mower which will make a five-foot cut is used. This size requires the services of a team of horses and a driver, and under average conditions a 5-foot mower will cut 10 acres in 10 hours. Now if that same man and team will operate a 6-foot mower it will cut 12 acres. If the man adds another team to the outfit, or uses a tractor to pull a 7-foot mower, he can cut 14 acres a day, and if an 8-foot mower is used about 16 acres can be covered in the 10 hours. Of course the wider mowers require more power than the smaller ones, but they require no more supervision, and accordingly the labor efficiency in haymaking can be almost doubled by the use of suitable implements. Where tractors are available, as they are on a large proportion of our farms, ample power is provided to operate any sized mower.

In a study of haymaking crews made by the Department of Agriculture, it was found that the same number of men and horses will produce varying results under different arrangements. For instance, where three mowing outfits are used, and all three men work close together, one mower following the other, each cutting a swath, less work will be accomplished in a given period than where each outfit works separately. This is due to two causes. When working close together, if one machine develops trouble and it is necessary to stop, all three mowers must stop, and the lost time is multiplied by three. Furthermore, when men work close together there is a decided tendency to talk, and this interferes with their efficiency. When each outfit is placed in a given field and works alone, better results are obtained, and there is no interference from other machines.

For a long time in the South it used to be the custom, and is yet to some extent, to use a big crew of negro laborers to turn over by hand the curing alfalfa and Johnson grass. In an actual test made in the same field, it was found that a farm boy, driving a team and operating a hay tedder, could turn over as much hay in a day as a crew of 12 negroes using pitchforks or rakes. Even where labor is plentiful and cheap it is not hard to figure out the most efficient method for turning hay. A hay tedder is a simple and comparatively cheap implement and should be on every farm where hay is grown.

Raking hay is another thing that can be done more efficiently by the use of proper implements. On many farms the 8-foot rake, operated by one horse, is used for this operation, but where the area devoted to hay is fairly large, this outfit is costly and inefficient. A 12- or 14-foot rake, drawn by a strong team or a tractor, will cover 50 per cent more ground and do the

(*Continued on page 167*)

**A sweep rake used in the West. This implement is said to reduce the labor by fifty per cent**

## Shade Trees for City Streets

By Alfred Longville

PROVIDING shade on city streets is as much a municipal function as providing lights or sidewalks and should therefore be cared for by public officials, says one of the horticulturists of the U. S. Department of Agriculture in a recent bulletin on "Street Trees." Trees on well-shaded streets not only contribute enjoyment but health by transpiring moisture and producing a restful effect on eyes and nerves.

Good shade adds to the value of adjoining properties. In fact, even in pictures, a house with trees and shrubbery will attract a buyer when the same structure without them would be disregarded.

Mixed plantings of different kinds of trees are not as pleasing and effective as the use of a single species for considerable distances. On the other hand monotony will result if the same species is used for an entire town or section. The varieties of trees suitable for city planting are not many, so all native to the section may be used, usually assigning one variety for a long stretch of street. Street trees are often planted too close together for the mature tree to thrive, a common practice being to plant them 35 feet apart although 50 or 60 feet would be ultimately a better distance.

A street tree must have healthy foliage that withstands dust and smoke, a root system adapted to unusual soil conditions, restricted feeding area and root pruning where street improvements are made. In the smoky heart of a city the ailanthus or tree of heaven will probably thrive when nearly all other kinds fail. So also may the sycamore and plane. These are suitable for nearly all sections of this country. The maple is not as suitable a tree for street planting as many suppose because it is not sufficiently rugged except under suburban conditions.

The top of a street tree should be in proportion to the width of the street on which it stands, and should be of open growth without being too spreading. Narrow streets should be planted with columnar trees like the Lombardy poplar, or sometimes with small trees; broad streets with spreading trees like oaks or elms. The oak is designated as best for nearly every section of the country because of its hardiness and beauty.

## Testing Biological Products in England

THE U. S. Public Health Service Reports that the Minister of Hearth of Great Britain has recently appointed a committee to consider and advise upon legislative and administrative measures to be taken for the effective control of the quality and authenticity of such therapeutic substances offered for sale to the public as cannot be tested adequately by direct chemical means. These include biological products, such as serums and vaccines, and mineral and vegetable bodies, such as salvarsan and digitalis, to which ordinary chemical tests are not applicable. In the United States the production and sale of viruses, serums, toxins, and analogous products are under effective Federal supervision so far as interstate commerce is concerned.

# The Racing Airplane of the Future

## (Reprint of a Study of Probable Future Developments, Originally Published in the Scientific American of Oct. 22, 1910)

By J. Bernard Walker

*THIS article, originally published during the great airplane meet at Belmont Park in 1910, was an attempt to forecast the lines along which the development of the airplane would proceed. It was an engineer's loose study of a problem, to which the engineering profession was about to apply itself with results of which we were to see the culmination on the battlefields of France and in the memorable flights across the Atlantic. The present-day interest of this article will be found in its fruitful anticipation of subsequent developments, as seen in the oval, streamlined nascelle and the sheltered position of the pilot; the substitution of interior metal wing beams for exterior ties and struts; the retractable chassis; the gyro control of the ailerons; and the use of alloy metal throughout, with corrugated metal covering for the wings. After a lapse of eight years, the Germans, in the summer of 1918, produced the Junker all-metal war monoplane, with internally braced wings, covered with corrugated metal. At the present time the retractable chassis, as suggested in 1910, is being made the subject of much experimental effort.*—THE EDITOR.

A STUDY of the trend of development in airplane construction renders it possible to predict with some degree of certainty the leading characteristics of the airplane of the future, and especially of that type which will be built purely for racing purposes. The following is an attempted study along these lines. The writer has no wish to assume the rôle of prophet, and the accompanying drawings and description are based mainly upon a survey of the work which has been done during the present year of phenomenal development by the designer, the constructor, and the airman. The keynote of this development is to be found in the fact that the speed of the airplane in straight-away flight has risen during the past year from fifty-five to seventy-five miles per hour and that the "blue ribbon" of the air (if we may borrow a nautical phrase) has passed from the biplane to the monoplane, the type which, at the present writing, is so far in the lead as to speed, lightness and stability, that it stands in a class by itself.

The racer of the future, then, will be a monoplane; and in narrowing down to this type, man is but treading in the footsteps of Nature, the master builder, who, working through a process of evolution that has stretched out over millions of years, has produced, in that wonderful bird, the albatross, the perfect flying machine. The future high-speed flyer, then, will possess the same tapering, rounded body and the widespread wings of narrow width which characterize the swiftest of the birds. Langley, in his classic researches, showed that it was the leading portion of a plane which was the most efficient, and this for the reason that it was continually moving on to fresh bodies of undisturbed air. He showed that as the after portion of the plane had to do its work upon air which had already received from the forward portion a downward velocity, this air was unable to provide the effective reaction which was exerted by air absolutely inert. Hence it follows that a plane 5 feet in width by 10 feet in length would be rendered more efficient if it were divided longitudinally, and the same area were presented in a plane 2½ feet wide and 20 feet in length. The wings of the racer will be long and narrow; and when they come to be built of metal instead of the present wood and fabric, it will be possible to give them those sweeping, rounded forms which prevent eddy-making, and also, from a constructional point of view, add not a little to the strength. The body will be of a generally circular or oval section; and to allow of a long and gradual taper, for ease in traversing the air, the body will have considerable length. The greater length also will add greatly to the fore-and-aft stability in flight.

The present wood-canvas-and-wire construction will have to go. It is makeshift work at the best, and was adopted because, in the early days of experiment, it offered a cheap and light combination of material, and one which, in the event of the inevitable breakages, incidental to experimental work, could be cheaply and quickly repaired. Its place will be taken by some one of the many remarkable alloys of steel which are now available—metals of enormous strength and toughness in proportion to their weight. The use of these, coupled with careful designing by the skilled engineer, will make it possible to produce an airplane of much greater strength, that will weigh no more than the present machine, and will present far less resistance.

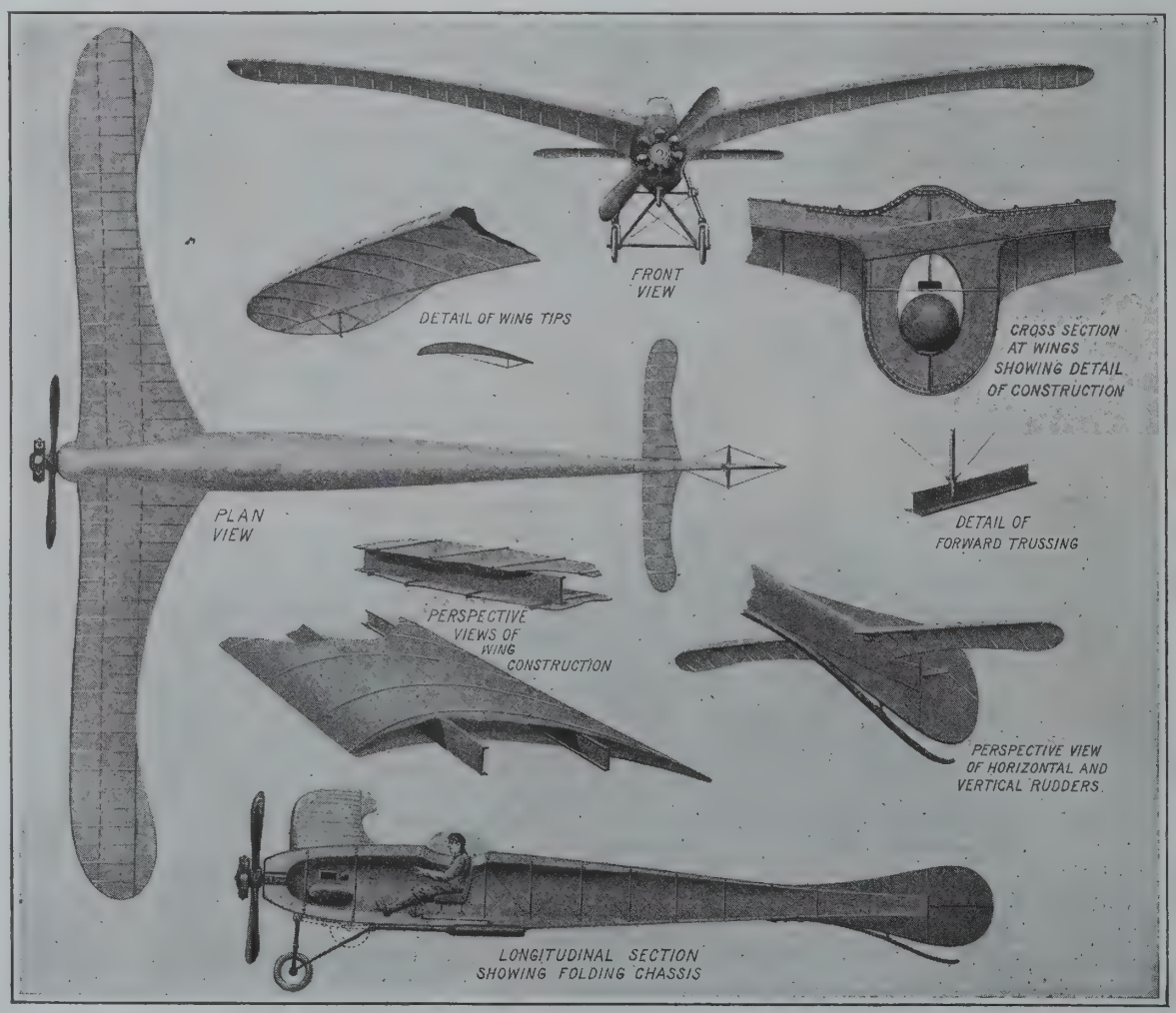
The principal resistances encountered by an airplane when in flight are those due to the lift and the head surface. The resistance due to the lift is fairly constant; for as the speed increases the angle of incidence decreases, and there is always an adjustment between the two which provides sufficient vertical reaction at all times to lift the weight of 500 to 1,000 pounds, as the case may be. The head resistance, however, increases approximately as the square of the speed; and if it is 100 pounds, say, at 40 miles per hour, it will rise to 400 pounds at 80 miles per hour. Hence the great importance, in a racing machine, of reducing the head surface to the least possible limit consistent with structural requirements.

It is the consideration of head resistance which has doomed the biplane as a purely racing type. When Octave Chanute built the first biplane glider, with its light, but very rigid Pratt trussing of vertical wooden struts and diagonal wire ties, he produced an excellent piece of engineering construction, which has proved to be ideally adapted to the early experimental stage which is now drawing to its close; but for high-speed results, because of the large amount of head surface presented, the Pratt truss was doomed to ultimate extinction. Unquestionably, the higher speeds which have been attained by the monoplane are due largely to the fact that its trussing is simpler, and the head surface, particularly of the wire stays, is relatively much less.

Now a word as to the resistance offered by a mass of tightly-strung wires. Professor Langley showed in his whirling-table experiments that the resistance of a wire is much greater than that which would be due to its projected area. As the speed increased, the resistance would rise rather quickly until, at a certain critical point, at which the wire would sing with a peculiar note, there was a sudden and very large jump in the resistance. This is explained by the fact that the rate of vibration of the wire under the rush of air is so great that it practically presents a solid surface, whose width is equal to the amplitude of vibration. Hence a tightly-strung wire presents a resistance to the air which is seemingly out of all proportion to its actual surface.

It follows, then, that even the simple king-pin trussing of the Blériot and Antoinette types must go if we are to achieve the high speeds which are predicted for the future racing machine. Now this will be possible only if some high-grade sheet metal is substituted for the canvas of the wing surface, and the necessary transverse bending strength is secured by means of plate-steel members enclosed within the wing surfaces and strongly riveted to the structure of the main body of the machine.

The form of wing shown in our drawings will afford a sufficiently strong construction in metal. The wings should widen considerably as they approach the body; for this would provide increasing space between the upper and under surfaces, and allow the depth of the channels to be increased proportionately to the bending stresses. These channels would be carried into the main body and riveted to transverse diaphragms, which should be so cut that the metal of the diaphragm would extend unbroken for some distance into the wings. We are convinced that by careful designing, the selection of the highest grades of steel, and by first-class workmanship, it will be possible to provide wings of ample strength without exceeding the limit of weight imposed by airplane requirements. Buckling in the fore and aft direction will be provided against by rolling the metal of the wing surfaces with shallow corrugations, as shown in the drawings. The main body of the airplane

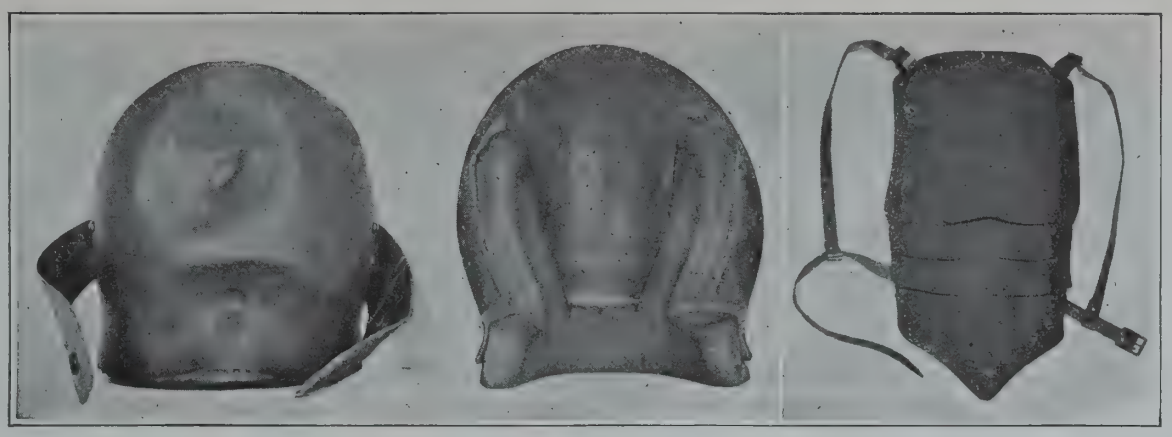



**This sketch, showing the probable development of future airplane designs and construction, was originally published in the "Scientific American" of October 22, 1910**

(*Continued on page 168*)

## Helmets and Body Armor in Modern Warfare

AMONG the many instances of a return to long-abandoned practice which were seen in the great war, was the universal adoption of the steel helmet and the tentative use of body armor. A work remarkable for its wealth of information has recently been written by Bashford Dean, Ph.D., Curator of Armor, Metropolitan Museum of Art, Major of Ordnance, in charge of Armor Unit, during the war. This book of 325 pages describes the various forms of armor designed and used for the American forces, and also discusses most entertainingly the helmets, body armor, et cetera, used by the principal nations engaged in the war. The work is most elaborately illustrated with line drawings and half-tones, and forms necessarily a most comprehensive, up-to-date work on this subject.



Experimental chin and face guard, front and rear views. Cushioned with sponge rubber

American laminated back plate of manganese steel. Stops 1000 f.s. bullet

In the years preceding the war, those of us who passed through the fine hall containing the Riggs Collection of armor at the Metropolitan Museum, regarded it as having an interest purely historical and artistic. Today we look upon those ancient and mediaeval forms with a new appreciation of their value. That armor could have been introduced during the late war and made effective, without loading down the soldier with an impossible burden, is due to the remarkable strides which have been made in the production of high-grade alloy steels of great resisting power in proportion to their weight. The bronze and other armor of the mediaeval times would not be effectual in stopping modern high-velocity bullets and shrapnel, but the manganese and other steels employed give to the modern soldier an immunity comparable to that enjoyed by the mediaeval armored knight against battle axe, sword and the swift-flying arrows of the Saxon bowmen.

We have selected a few illustrations from this volume which are characteristic of the several hundreds with which it is richly illustrated. Among these is a type of face guard, a device to accompany a helmet of the British type. This is an adaptation of the face guard of the fifteenth century. It encloses the face, rests on the chest and is held in position, not too tightly, by leather bands provided with snap fasteners. To absorb the shock of impact, the guard is provided with a lining of sponge rubber. This guard stopped the automatic revolver bullet at ten feet. A number were sent to the training camps and tried out and although the soldiers complained that it was a bit "stuffy," there can be no doubt of its value. That it is practical seems clear from the fact that the same form was in general use in Europe from 1450 to 1550.

We also reproduce the photograph of an experimental American body armor which consists of five pieces. The upper and larger portion covers the chest and stomach; to this are riveted two sections which protect the abdomen; below this, attached by leather straps and buckles, are two pieces of armor which afford protection to the upper part of the thighs. This armor is made of Baker's nickel-manganese alloy, and in the tests, at a distance of 200 yards, it served to stop a rifle ball fired with an initial velocity of 2,800 feet per second. With this may be compared the British body armor brought out in 1917-18. In its effort to furnish an improved type of body defense, the British Government, through its Munitions Inventions Board, manufactured the corselet which we illustrate. It weighs nine and one-half pounds and is formed of three elements—a breast plate, a back plate, and what is called a "sporran" piece. These are covered with khaki drill and are slightly padded. It will resist the ball of the automatic pistol, and also shrapnel and grenade. It will stop a bullet traveling at a rate of 1,280 feet per second. The plates are made of twelve per cent Hadfield's manganese steel of eighteen gage. This model was issued in pretty large quantities.

Between these samples of American and British armor we show an American model helmet which, if the war had continued, would probably have super-

(Continued on page 168)

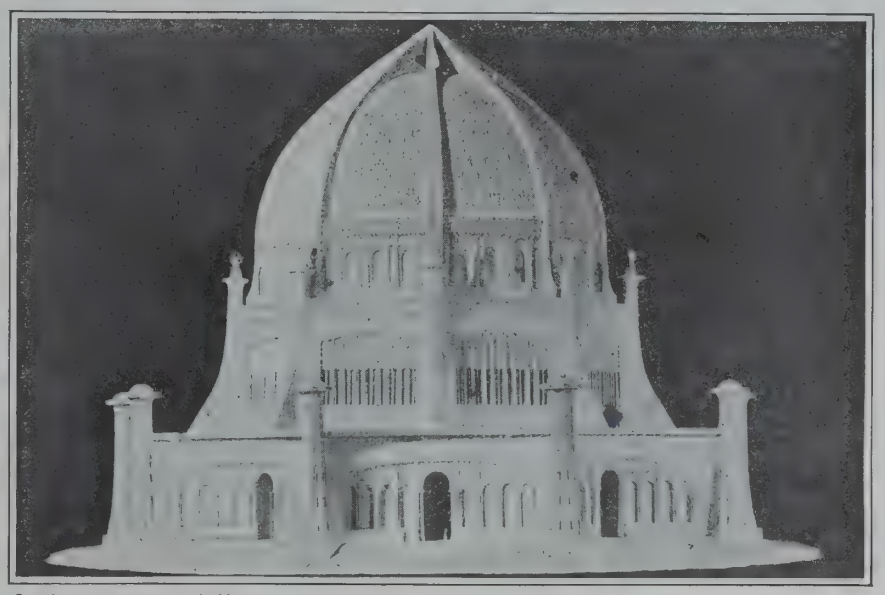
Experimental American body armor. Stops rifle bullet at 200 yards

American helmet No. 2. Improvement on British type. Protects back and side of head

British body armor of 1917-18. Stops rifle bullet at 1280 feet per second velocity

## Exotic Temples for Our Two Greatest Cities

A NEW religion, a new style of architecture—a style derived from astronomy, these are all things to animate the jaded mind after the war languor. A new religion coming from the East is a matter of course and hardly causes a ripple of either interest or enthusiasm; but the idea of a combination of religions or rather unity of nine which is unity in "spirit and in truth," is most extraordinary. Let us for the sake of argument have a religious "League of Nations" with the capitol in Persia, the chief promoter living in Palestine and the two great temples in Chicago and New York! This is an astounding proposition in itself, without considering for the moment the architectural setting for the two temples. We might as well tell the name of this new cult now as later—it is the "Bahai Movement," which, according to its devotees, is to weld together all the religions of the world in a common religious unity. The idea is common enough, and has been shaking the universe since the "Oxford" or "Tractarian" movement in the middle of the last century. It is the desire to gain unity without undue concession which animates all real inquirers.



Copyright by L. Bourgeois, Architect

An exotic Bahai Temple for the metropolis of the East and of the West

The Bahai movement assumes that there are nine of the great religions and that in a temple there should be nine sides with doors over which are inscribed a welcome in the language of the race to which the portal belongs. Within we are not to see nine pulpits with nine kinds of priests, rabbis, or exhorters in nine kinds of vestments or without them. The paraphernalia of religion is left out in the daylight, and in the dim religious light we have worship, music, and, above all, beauty. The effect produced on the visitor would be something akin to that wonderful Masonic Scottish Rite Hall in Washington where even the most hardened atheist and sinner would be softened by the combination of music and dim religious atmosphere. There is no other creed than the brotherhood of man and no other organization than a body of temple trustees who will govern the fabric.

The plans of the architect, Louis Bourgeois, differ somewhat in his earlier and later models, but our illustration suggests a compromise design which for real beauty is almost without a peer.

The architect has wrought into his decorations such symbols as the cross, the swastika, the five, six and nine-pointed stars. The use of vines, leaves and figures has been eschewed and purely mathematical lines have been substituted. The architect has derived his inspiration from the study of astronomy, for the overlapping curves which the planets trace in their different planes are very beautiful as they circle around in the heavens. The dome is the essential feature and somewhat suggests the so-called "Dome of the Rock" in Jerusalem, wrongly called the "Mosque of Omar." The external ribs are most pronounced, meeting in a Gothic point, suggesting hands clasped in prayer above the head.

The first story is Roman in its window arches, while the second is more Greek, and the next story suggests Chinese influence. In fact, it is a remarkable architectural blending. The building will cost several millions, but the result will be worth it.—By *A. A. Hopkins.*

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

Copyright, Kadel & Herbert

**Tearing a piece of wrapping paper from a roll placed below the counter**

## Keeping the Wrapping Paper Out of the Way

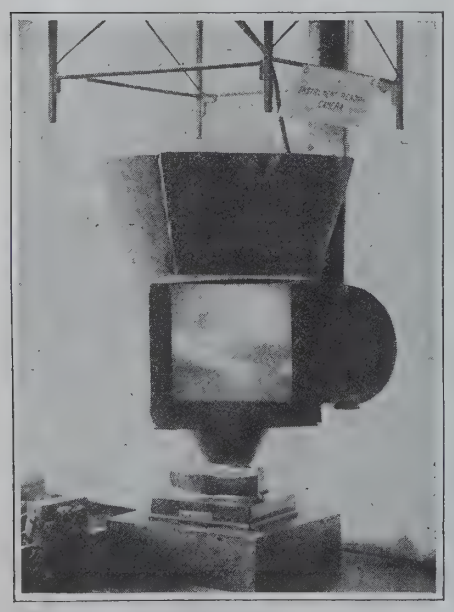
ONE of the latest aids to speeding up the wrapping of packages in stores and shops is shown in the accompanying illustration. It consists of a brass-lined slot in the counter top, through which protrudes the end of a roll of wrapping paper kept below the counter. When a piece of paper is wanted, the end is pulled until the desired length is attained, and by pulling the paper at an angle it is cleanly torn by the brass sides of the slot as shown. Not only does this arrangement save considerable room on the counter, but it is said to be considerably more convenient than the usual paper holder and cutter.

## Magnifying the Meter Scale for Better Readings

CENTRAL electrical stations and laboratories of public utility commissions, where rapidity and accuracy in testing of electrical apparatus are desirable, will find useful an instrument reading camera recently developed by the U. S. Bureau of Standards. The time element in testing instruments is appreciably reduced and only faults inherent in the electrical equipment are detected as errors. Any possible discrepancy of reading at the time of the test is virtually eliminated.

The scale of the instrument subjected to the test is brightly illuminated by a concentrated filament tungsten lamp and a system of mirrors and condensing lenses. Another lens and a right angle prism are mediums for flashing upon a ground-glass screen an image of the scale and pointer, magnified by five diameters. The enlargement of the object greatly reduces the possibility of error in reading the electrical instrument and when properly adjusted eliminates parallax error.

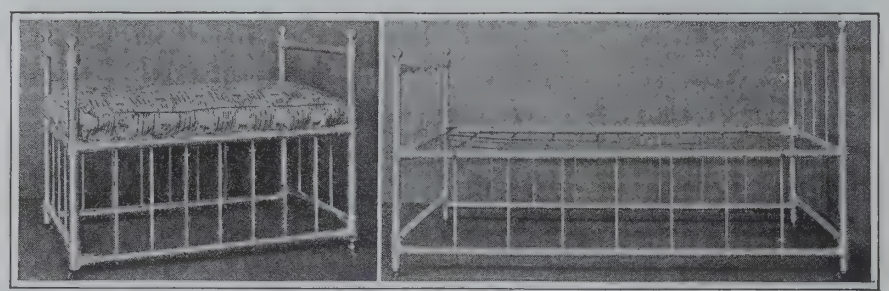
The reading camera is easily adapted to making observations from either vertical or horizontal scales. By the use of this device the results are more satisfactory as both eyes can be kept open and the head held in any convenient position. The reading camera is especially valuable in laboratories such as those maintained by central stations and public utility commissions where the position of a pointer over a scale is to be read rapidly and with considerable accuracy.



**This instrument shows up the meter reading in greatly magnified form for convenient reference**

## Furniture That Comes in Bundles

SOME ingenious Frenchman has invented a system of knock-down interchangeable unit furniture that is certainly unique and perhaps practical as well. The basis of this system is to be found in a collection of rods, tees, elbows and other fittings, which can be assembled in many different ways to form all sorts of furniture. The rods and fittings are bought in a store, and the purchaser then proceeds to make any desired bed or other piece of furniture within the limitations of the system. For instance, sufficient rods and fittings can be bought to make a small crib for the infant, and later, when the infant has grown to childhood, additional rods and fittings can be bought in order to enlarge the crib or even change it into a single bed or couch. The system also lends itself to making tables, settees, wardrobes and other furniture, although its prime purpose is for beds.



**Beds and settees of almost any size and design can be made from this ingenious system of rods and fittings**

## Machine-Made "Real" Lace

AN invention has just been patented for the manufacture of imitation "real" laces, by H. F. Soar, of Nottingham, which it is claimed will revolutionize the present methods of making imitation "real" laces. The inventor states that by the means of his invention, which is an attachment to an ordinary Levers lace machine, he can produce the lace the entire width of the machine, either in breadths from one inch upward or the full width of the machine for allover nets. Thus, a machine 100 inches wide could be made to produce 100 breadths of one inch, or 50 of two inch, and so on. Two sets of jacquards are used, one operating the warp threads and the other the bobbin threads.

The inventor considers that these machines can be worked by female labor, and that the laces could be produced cheaply. Hitherto imitation "real" laces have been made on the small, rapid, circular machine which weaves but two breadths.

## A Bicycle That Rides on Rails

RAILROAD inspection and repair work on a very modest scale are somewhat simplified by the introduction of a French invention which permits an ordinary bicycle to be ridden over railroad tracks in the manner shown in the accompanying illustration. The device consists of an attachment which serves to hold the bicycle squarely on one rail. The result is that the bicycle can be driven at a high rate of speed over the perfectly smooth surface formed by the rail. When the rider wishes to change from the railroad to an ordinary road, he merely detaches the simple framework, folds it up, and proceeds in the conventional manner by carrying the light framework along.

## Putting the Stove Chimney to Useful Work

THE fuel scarcity that prevails throughout most of Europe has aroused inventors to put forth their best efforts on the problem of securing new fuels on the one hand, and getting more heat out of old fuels on the other. A short while ago we presented in these columns an English invention for getting heat out of compressed sawdust. This time we present a French invention for getting more heat out of the conventional stove by changing the arrangement of the chimney.

The French call this latest invention the "spirale radiatrice," or heat-radiating spiral, so to speak. It consists of a stove chimney made in the form of a spiral and connected at either end with the usual chimney which passes through it. In actual operation the draft from the stove can be made to pass more or less through the spiral passage by means of suitable draft valves, in accordance with the requirements of the fire. The more draft passes through the spiral passageway the more heat is obtained from what would otherwise be wasted heat passing up through the chimney.

**This simple framework enables the railroad worker to ride a bicycle on the railroad tracks**

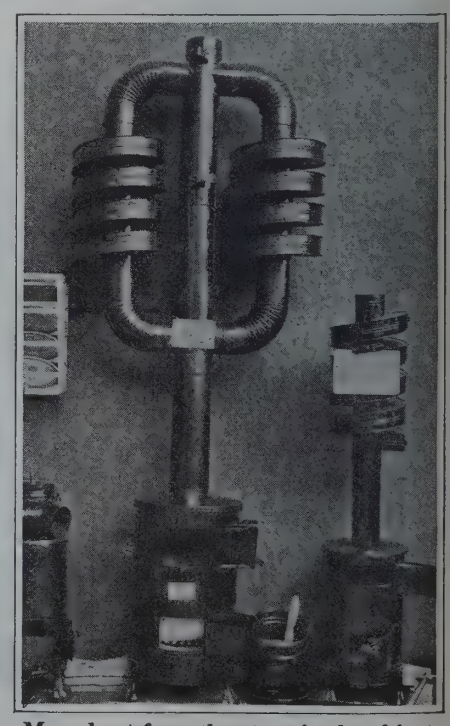
## Electrical Sterilization of Milk

A SPECIAL report has just been issued by the British Medical Research Committee, dealing with the destruction of bacteria in milk by electricity. In the introduction it is pointed out that the earliest description of an electrical method having this purpose in view was published by the Liverpool (England) Corporation in 1915, the investigator being Prof. J. Martin Beattie, of the University of Liverpool. Subsequently independent trials of the method were undertaken at Birmingham, and the opinion of the committee is that these latter experiments, while supporting the practical results obtained at Liverpool, did not entirely prove whether the electrical current in the method adopted had a directly bactericidal action or acted as a thermal agent. Sir Oliver Lodge inclined to the latter view.

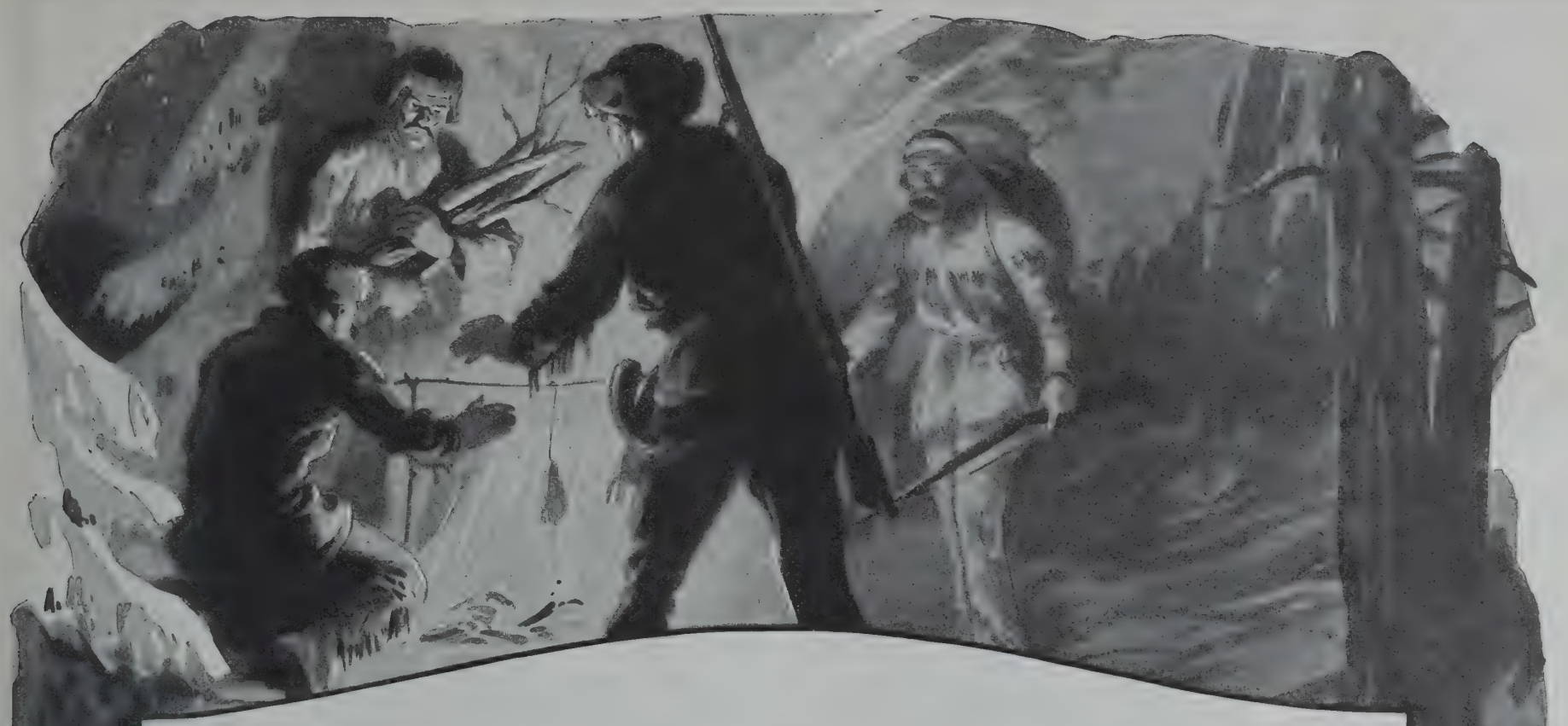
The report itself has been prepared by Professors Beattie and Lewis, both of Liverpool University, and enumerates the results of 15 experiments under varying conditions, with different degrees of current and with several qualities of milk, as well as showing two types of apparatus used. The final conclusions arrived at by the investigators are:

Milk can be rendered free from *B. coli* and *B. tuberculosis* by the new electrical method described without raising the temperature higher than 63° or 64°C. This temperature effect is very short in duration and in itself is not the principal factor in the destruction of the bacteria. Though the milk is not sterilized in the strict sense of the word, yet the percentage reduction of the bacteria taken over a period of a fortnight is 99.93. The keeping power of the milk is considerably increased.

The taste of the milk is not altered, and so far as careful chemical examination can determine the properties of the milk are not in any way impaired. The milk can accurately be described as "raw milk" free from bacteria.



**More heat from the stove is the object of these spiral draft chimneys**



# *Coal and Wood say, "Come to me for heat" Electricity says, "My heat is at your finger tips"*

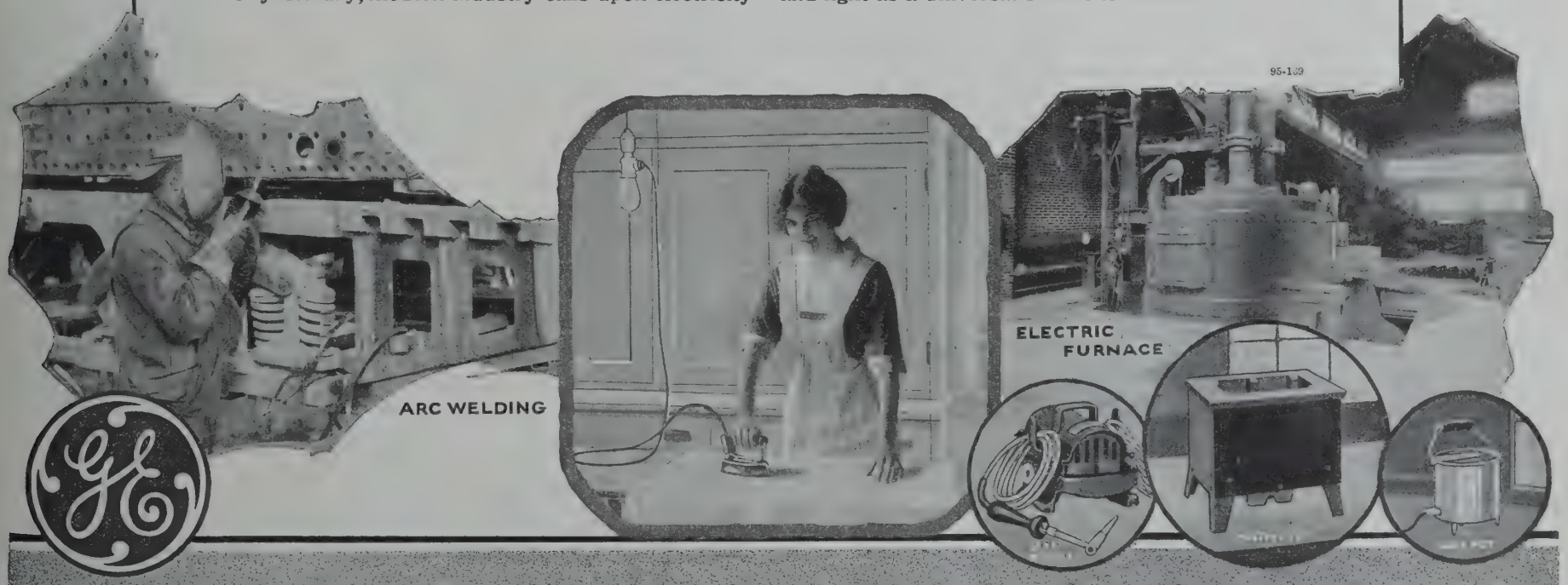
CAN you imagine a fire in Chicago and benefiting from its heat in New York? Yet that is what virtually happens in the case of electric heat. A current is generated, sent miles across country and converted into heat, wherever desired—instantly available, easily controlled and concentrated to the highest degree.

Domestic needs have produced the electric oven, cooker, broiler, toaster, flat iron, hair curler, percolator, glow heater and grill. These have eliminated drudgery, reduced fuel bills and fire risks, promote cleanliness and simplified housekeeping. In some states plentiful power from water sources and scarcity of fuel have made the heating of homes by electricity practical and economical.

In place of the grimy forge and the primitive bellows of yesterday, modern industry calls upon electricity to heat rivets, to alloy and temper metals, to weld and cut, to bake enamels and varnishes, and to perform speedily and more efficiently the thousand and one tasks that require heat. Electric furnaces, arc welders, glue pots, soldering irons, brazing machines—each one has the proper control to produce just the right amount of heat.

The broad utilization of electric heat has only begun. It has already called upon every resource of the General Electric Company: study, research, engineering and manufacturing.

While the problem of obtaining more power by connecting cities with far away water power and steam plants is being solved, the efficiency of the application of electric heat will also be studied so that electric heat may take its place with power and light as a universal benefit to mankind.




GENERAL ELECTRIC COMPANY

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

## Of Interest to Farmers

CULTIVATOR.—R. S. MATTINGLEY, Rockport, Ind. An important object of the invention is to provide a cultivator of the straddle-row type which may be readily and easily adapted to the cultivator of a great variety of crops and in which all of the subsidiary operations incidental to the use of the cultivator such as the adjustment of the cultivating or earth-working elements, the steering of the cultivator; the control of the draft, etc., may be efficiently carried out under the control of a single operator.

SHEAF DISTRIBUTER FOR THRESHERS.—R. B. MASON, 19 W. Patriot St., Somerset, Pa. The invention relates to distributing devices, more particularly to be used in connection with a thresher. An object is to provide a sheaf distributer for alining the sheaves and conveying them in an orderly manner to a thresher with which the distributer coöperates.

CONTAINER FOR SHEAF LOADERS.—R. B. MASON, 19 W. Patriot St., Somerset, Pa. One of the foremost objects of the invention is to provide a form of bottom for a sheaf container, which consists of a plurality of independently movable conveyers which can be separately actuated to shift the load into more advantageous positions. Another object is to provide a mechanically actuated gate cooperating with the movable bottom of the container, the gate being adjustable either high or low to regulate the quantity of sheaves discharged.

## Of General Interest

SQUEEZER.—S. E. CREASEY, Sanford, Me. The invention relates to juice extractors commonly known as "lemon squeezers," which may of course be used for other fruit. An object is to provide a device which is provided with an opening in the upper end of its ribbed or corrugated conical body portion to accommodate the core of the fruit, and which will also operate to cut the fibers connected to the core and thus expose the meat to the squeezing action against the surface of the core to thoroughly extract the juice.

BROOM.—T. A. VOSS, Phoenicia, N. Y. More particularly the invention relates to that class of brooms the sweeping or dusting portion of which is folded and retained in a binder by a retaining bar seamed in the ends of the binder. An object is to provide a device whereby old newspapers can be utilized for the sweeping element, by so constructing the broom head as to permit newspapers or other foldable sheet material to be quickly put in place to sweep and is readily removed for renewal.

HEEL FOR SHOES.—A. B. SCHAEFER, 140 W. 10th St., New York, N. Y. The invention relates more particularly to heels of the resilient type. The primary object is to provide a lift for heels which is readily detachable from the heel proper when the lift has become worn. A further object is to so construct the heel that it may be readily attached and detached so as to render unnecessary the services of a person skilled in the art of shoe manufacturing or repairing to carry out the operation.

PERFUME VIAL.—A. VERICEL, 315 W. 136th St., New York, N. Y. The invention relates to a method of disseminating perfume and the provision of a perfume vial. The desired evaporation of certain perfume oils may be obtained if minute particles thereof are exposed to contact with the air for evaporation. The object is to dispense the perfume without the use of alcohol; this is accomplished by providing capillary means through which the perfume oil passes to contact with the air.

FLOATING DEVICE.—G. JORDAHAN, Palm Beach, Fla. An object of the invention is to provide a device in the form of a life preserver wherein a proper supporting member is provided when wanted and a light package when not wanted. Another object is to provide a device which may be tied around the body or fastened in a number of ways without effecting its usefulness, and which may be folded into a minimum sized package when not in use.

SELF-OPENING CONTAINER.—C. GUERITEY, address C. S. Humphrey, c/o Manhattan Can Co., Bush Terminal Bldg., No. 10, Brooklyn, N. Y. The invention relates more particularly to a container which is air-tight and adapted to be self-opening. Among the objects is to provide a container having a cover and a main body portion which is simple in construction, economical to manufacture and which may be opened without requiring the use of instruments or other means for separating except merely dropping the box suddenly. The box is particularly adapted to receive paste or other semi-liquid material.

WOODEN SHOE OR SANDAL.—P. DEMARMELS and A. WINKLER, 161 Avenue B, New York, N. Y. The object of this invention is to provide a wooden shoe or sandal having a wooden sole made in sections hinged together to provide a desired flexibility and thus to insure ease and comfort in walking. Another object is to conceal the hinges connecting the sole sections to prevent the corroding influences such as moisture, water, acids and the like from reaching and injuring the hinges.

RIMMED EYEGLASSES AND SPECTACLES.—S. GOLDFADEN, 609 W. 114th St., New York, N. Y. The invention relates to eyeglasses having rims of shell, celluloid or other similar material. The object is to provide rimmed glasses and spectacles whereby an optician is enabled to quickly and conveniently fit any one of the many types of bridges or temples to the rims as desired by a customer, and to permit the optician to conveniently place the lenses in position in the rims without requiring heating thereof.

FALSE BOTTOM FOR GARBAGE RECEPTACLES.—C. J. JACOBSSON, c/o M. Rock, 315 5th Ave., New York, N. Y. The object of the invention is to provide a false bottom of paper or similar cheap material for garbage cans and similar receptacles used in households, restaurants and other establishments, and arranged to maintain the receptacle in a sanitary condition when emptying it of its contents, especially protecting the bottom of the receptacle against adherence of moisture, fats and like matter.

COVER REMOVER.—A. S. MORANGE, 129 King St., Northampton, Mass. This invention relates to cover removers and has reference more particularly to a cover remover provided with means adapted to first cut the label on a can and then lift the cover with a wedging action. Another object is to provide a cover remover especially adapted for removing the covers of cans without spilling the contents thereof or damaging the cover.

COFFEE URN.—A. M. SALAZAR, 108 W. 44th St., New York, N. Y. The primary object of the invention is to so arrange the process of making coffee that the ordinary coffee urns commonly used in restaurants and like places may be eliminated and the liquid coffee made direct from the water boiler generally employed in restaurant kitchens. A further object is to provide a device in which various quantities of coffee may be brewed at a single operation.

ROLL-FILM CARRIER.—O. C. HUMMEL, Box 86, R.F.D., No. 2, Nauvoo, Ill. An object of the invention is to provide a neat carrying case for containers of roll films in which a number of containers for film rolls may be carried and protected from the weather and in which means is provided for inserting containers having exposed films at the bottom of the carrier and for removing containers having unexposed films at the top.

SHOE STRETCHER.—H. WATERS, Box 182, Bisbee, Ariz. The object of this invention is to provide a device by means of which the shoe may be stretched in many directions either longitudinally or laterally at different points or in a vertical direction; a stretcher plate is provided which may be set in place at the point where it is desired to stretch the shoe.

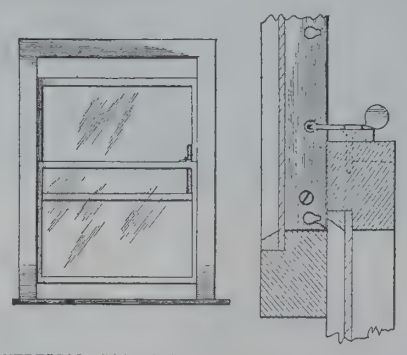
SELF-RAISING LID FOR ICE-CREAM CABINETS.—C. R. RAGSDALE, c/o Liquid Carbonic Co., 539 Magazine St., New Orleans, La. The general object of this invention is to provide a lid of the indicated character provided with means whereby to automatically throw the lid to the raised position whenever the latch means releases the lid. More specifically the object is to provide an embodiment of a simple and durable form as well as convenient to install.

OIL CAN.—J. H. HALL and W. B. HAMILTON, Rupert, Ida. This invention has for its object to provide an oil can having means for permitting the oil to be forced from the can in spurts or in a steady stream by grasping the can between the thumb and the first two fingers and making pressure with the thumb toward the fingers with the can so held.

ROOFING.—R. W. BLANTON, Ironton, Ohio. The invention relates to sheet metal roofing. The object is to provide lock-joint metal roofing sheets of such formation that not only can successive sheets of one course be interlocked, but successive courses can be lapped over each other, the lock-joints of one course coming substantially in the middle of the sheets of the course below, thereby staggering the lock-joints and forming what is known in the art as a "break joint" construction. A further object is to provide lock joints which will not become separated by expansion and contraction under the influence of heat and cold.

## Hardware and Tools

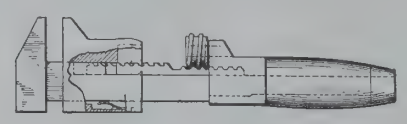
WINDOW LOCK.—R. BELLINGER, 226 E. Main St., Chicopee Falls, Mass. The object of the invention is to provide a window locking device which will lock a window in closed position or in any of several open positions so as to secure ventilation at the top or bottom of the window or both, the device when in



A VERTICAL SECTION OF THE DEVICE AND CONVENTIONAL FORM OF WINDOW WITH DEVICE APPLIED

locking position preventing rattling of the window. The lower sash is provided on its upper edge with a locking member which co-acts with a keeper secured to the upper sash for locking both the sashes against movement relatively.

WRENCH.—H. B. WINTER, County National Bank Bldg., Punxsutawney, Pa. This invention has for its object to provide a wrench wherein a fixed jaw is provided with a movable jaw adjustable toward and from the fixed

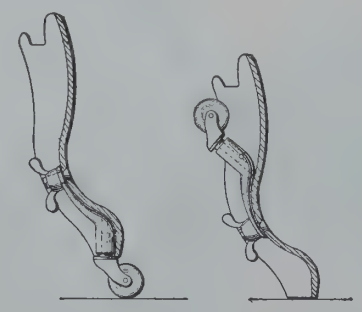


A SIDE VIEW WITH PARTS BROKEN AWAY

jaw with a coarse and a fine adjustment, the said adjustments being independent of each other. In order to attain the coarse adjustment the movable jaw is tilted and moved toward the fixed jaw to engage the object; when so engaged the fine adjustment may be attained by means of a worm.

## Heating and Lighting

CASTER ATTACHMENT FOR STOVE LEGS.—J. O. SABOM, 616 Tower Ave., Superior, Wis. A purpose of the invention is to provide an attachment for supporting a caster on a stove leg in such manner that the caster



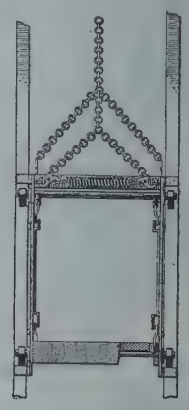
SHOWING THE ATTACHMENT IN ACTIVE AND IN INACTIVE POSITIONS

will extend below and support the leg to facilitate the movement of the stove from place to place, but the caster is capable of being moved to an inactive position after the stove has been moved and will function as before to prevent accidental movement of the stove.

HEATER FOR WASHING MACHINES.—H. S. CARSON, 139 Prospect St., Stamford, Conn. The invention relates to a heater which is more particularly applicable to washing machines, and aims to provide a device wherein the soapy water usually wasted may be heated again and reused; means are associated with the heater for maintaining the fluid at a proper temperature. A further object is to associate the heater with the washing machine in such manner that the fluid may be drained from the heater into the washing machine, or vice versa.

## Machines and Mechanical Devices

SAFETY DEVICE FOR ELEVATORS.—L. COURTY, Windsor, Mo. An object of the invention is to provide a simple and durable safety device for elevators in which the elevator will



FRONT ELEVATION OF ELEVATOR EQUIPPED WITH THE DEVICE

be securely and positively locked to the guide rails when the supporting cable does not serve to support the elevator or breaks, or whenever the elevator is in danger of falling irrespective of its position in the elevator shaft.

HEDDLE.—H. RUEGG, JR., 12 Kingswood, Weehawken, N. J. The inventor has been granted two patents relating to heddles for looms. The objects are to provide a heddle arranged to permit the weaver to readily engage a warp thread with the eye of the heddle without the use of a hook or similar tool. Another object is to prevent the warp thread from passing accidently out of the eye on raising and lowering of the heddle. A still further object is to permit of making the heddle of one single strip of metal or other material.

CUTTING AND ROUNDING-OFF MACHINE FOR TEETH FOR CLOCKS.—F. L. W. BUCKMANN, Amsterdam, Holland, Netherlands. This invention relates to a machine for cutting and rounding off the teeth on spur and bevel toothed wheels and pinions for the clock work and instrument makers' trade; an object is to make the machine very simple and compact in order that it can be easily handled in the clockwork makers' and instrument makers' trade.

EQUIPMENT FOR MOVING PICTURE MACHINES.—R. N. VYNE, c/o Vyne Bros. Electric Co., Reif Bldg., Prescott, Ariz. The object of the invention is to provide equipments for moving picture machines whereby a shutter is interposed between the distant screen and the source of light of the corresponding moving picture projecting machine used at the time with a view to prevent the undesirable red afterglow appearing on the distant screen on stopping the projecting machine. Another object is to keep one shutter of the non-active machine closed while the other shutter for the machine in use is open.

LIQUID MEASURING DEVICE.—J. D. MEREDITH, 60412 8th St., Wichita Falls, Tex. More particularly the invention relates to liquid measuring devices for dispensing gasoline, oil and the like. An object is to provide a device which will actually indicate both to the buyer and seller the amount of liquid dispensed. A further object is to provide means which will permit the buyer to see the condition of the gasoline before it is delivered from the machine.

FUR SCREEN.—T. TRAVIS, c/o Knox Hat Co., Grand Ave., Brooklyn, N. Y. This invention relates to screens for receiving fur from felt pad forming machinery, and has for an object to provide a construction which will continuously operate and thereby obviate the necessity of shutting down at any time. A still further object is to provide a screen whereby air may keep the screen clean and at the same time escape as the fur matter passes a receiving container.

PUMP.—H. JACKSON, 1633 E. 13th St., Brooklyn, N. Y. The invention relates to a pump which is peculiarly adaptable to the

(*Continued on page 164*)

# Organization—Equipment—Knowing-how Produces the new Leland-built Motor Car

In this day of big things, what more magic words than these: 'Organization,' 'Equipment,' 'Knowing-how?'

Without them is nothing great accomplished.

With them, nothing seems impossible.

Many are the stories of vast achievement in the world mechanical; among them is a story not widely known, yet a story for whose parallel you would seek far to find.

In order to understand the possibility of that achievement, let us hark back some thirty to forty years.

Then, Henry M. Leland was a conspicuous figure, in New England's higher craftsmanship.

Some years before, he had left his boyhood home on the farm in Vermont, and gone to Worcester, Mass., where he engaged as an apprentice. He became a workman at the bench, but not for long, because he soon compelled recognition as an artisan of an uncommon kind. He showed an ability to do things— to do them differently, and to do them better than they had been done before.

He became a machinery salesman, and an unusual one, because he was more than a salesman.

He knew, too, how to install and to teach the operating of the machines he sold.

Manufacturers sought his counsel. They engaged him to re-organize their equipment and their men.

He knew how to increase production, not by oppressive, but by progressive methods. He did two more things, which to those who do not know him and his methods, may seem anomalous or impossible — yet he did them.

Besides increasing volume, he actually reduced production costs, and at the same time bettered infinitely the quality of the things produced.

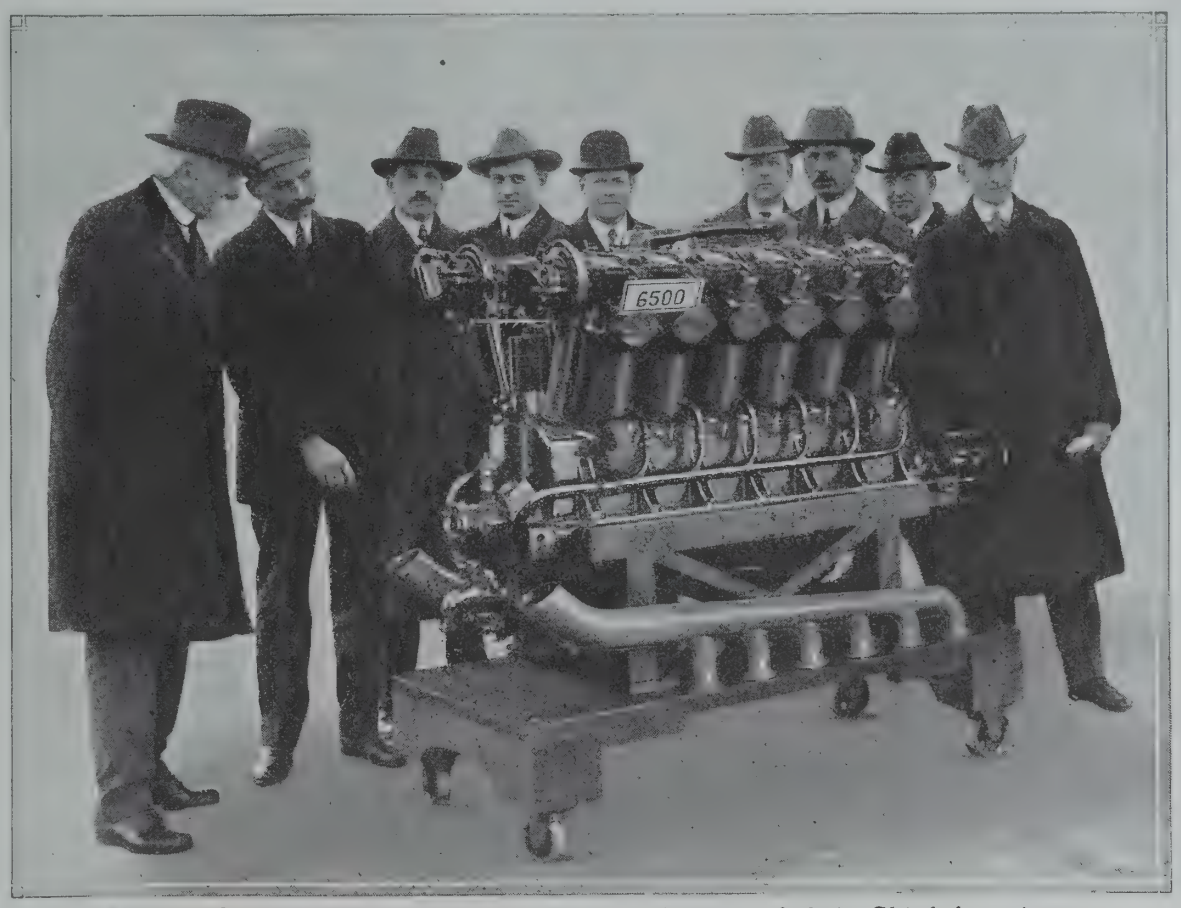
He had a knack and a penchant for doing things while others were saying they could not be done. His was supreme delight to bring order out of chaos.

Many are the great establishments today which owe the foundation of their prestige and their success largely to the organizing, producing and quality-building genius of Henry M. Leland.

He is credited with a multitude of 'crowning achievements,' because he has made it a life principle always to do things better than they had been done before.

His generalship in organization is strikingly exemplified in that of the Lincoln Motor Co., although he maintains that Wilfred C. Leland who has been his mainstay and close associate for many years, assumed a large share of the responsibilities; and to its success he also attributes the loyal, skillful and effective co-operation of his thousands of other associates.

In the year 1890 the Lelands came from New England to Detroit, where for a number of years they engaged in the manufacture of the finer kinds of machinery and precision tools. They were among the pioneers in the making of gasoline marine and automobile engines; and after eighteen years, many of those engines are still in service—a tribute to the Leland ways of doing.




*Henry M. Leland, Wilfred C. Leeland and some of their Chief Associates, viewing the 6,500th Lincoln Liberty Aircraft Motor*

*Of these nine men, seven have been in continual relation for 12 years; five for 21 years and three for 27 years*

***A Duplicate of this Motor is now in the Smithsonian Institution at Washington, D. C., where it will stand for all Time, a Monument to and an Example of the world's finer Craftsmanship***

Shortly after our country became involved in the world conflict, the vital need for aircraft so forcibly impressed itself upon the Lelands that they severed their many years' affiliation with the motor car industry, in order that they might undertake the production of Liberty airplane motors for the allied fighting forces. This they did in July, 1917.

With absolutely nothing in the way of plant or equipment, they received the government's first award for the building of these motors—and faith in the men and their ability was the government's sole assurance.

Capital was interested, and much volunteered. The Lincoln Motor Co. was formed. Fifty-two acres of land were acquired. An adequate plant was erected and equipped in record time. A vast amount of machinery was designed, built and installed. Tools to the extent of 6,522 separate and distinct designs, aggregating 91,807 in number were made.

Thousands of America's most skilled craftsmen tendered their co-operation and their services. Many of the men, particularly the executives, were men whom the Lelands knew and who knew them, through many years' association; and they were anxious to enlist under their banner.

Never in their lives, say the Lelands, have they seen such a vast organization get into working harmony with so little delay and so little friction.

The efficiency of that organization can best be appreciated when it is realized that in seven months and three days after starting with nothing, they assembled their first motor. In ten months thereafter, and with 6,000 employees, the Lincoln Motor Co. was producing at the rate of 50 motors per day. In contrast with these Leland methods, the leading English manufacturer, with three years' aircraft experience and 10,000 employees, had required a week to produce the quantity of motors which the Lincoln organization had produced in a single day.

Within eleven months from the day production of completed motors began, the Lincoln Motor Co. had established the record of producing the largest number of motors in a day, the largest number in a month and the largest total produced by any manufacturer from the beginning; and those who know the story of Liberty motor building know the rivalry for that record.

The quality of Leland-built Lincoln Liberty motors has been attested by tributes and in ways which could not be misunderstood; and, too, the Lincoln Motor Co. was able to render assistance of immeasurable value to those less favorably schooled.

Assembling and harmonizing an organization expeditiously, for doing things in a big way and doing them right, is, like everything else—no matter how difficult it may seem—a plain, simple matter of 'knowing how.'

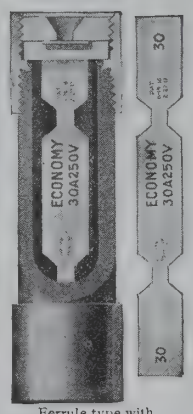
This is simplified when the executive and his chief assistants in things mechanical can go into the shops, and with their own hands perform practically every task and operation, from the ground work to the finished product.

Such is the skill and genius; such is the organization that is producing the new Leland-built car —the car destined to chart the future course of fine car making—the car destined to prove another 'crowning achievement'—the car destined once more to demonstrate Leland determination and Leland ability to surpass.

LINCOLN MOTOR COMPANY DETROIT, MICHIGAN

## You Buy the Highest Type of Electrical Protection

in any circuit when you install Economy Renewable Fuses—made in both ferrule and knife blade types in all capacities.



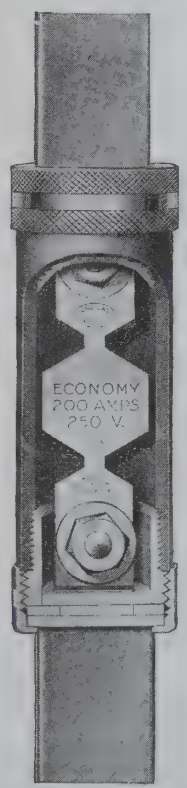
Ferrule type with Economy "Drop-Out" Renewal link

Accurate rating, practical, safe fuse construction and a dependability which has been proved for years in thousands of industries, large and small, make Economy Fuses first choice where efficiency is the first consideration.

# ECONOMY *renewable* FUSES

## And You Cut Fuse Maintenance Cost 80%

compared with the maintenance cost of any "one time" fuse equipment.



Knife-blade type with Economy "Drop-Out" Renewal link

Only the "Drop Out" Renewal Link is destroyed when the fuse blows.

Both ferrule and knife-blade types are easily and quickly restored without expensive delay in service.

**Economy was the first line using inexpensive bare renewal links for restoring blown fuses to their original efficiency to be APPROVED IN ALL CAPACITIES by the Underwriters' Laboratories.**

***Sold by all leading electrical jobbers and dealers***

**Economy Fuse & Mfg. Co.**
**Chicago, U. S. A.**

Economy Fuses are also made in Canada at Montreal


## RECENTLY PATENTED INVENTIONS

(*Continued from page 162*)

pumping of fluids, such as oil, water and gasoline although the same may be used for any fluid. Among the objects is the provision of a single valve which will present two separate pistons, so that all parts such as springs, etc., may be eliminated, a tight seal formed within the pump, a bearing which will efficiently lubricate the moving parts and to so construct the pump that it is impossible for the most unskilled laborer to apply the same improperly.

FIREPROOF FILM REEL.—W. RICE, 88 Cumberland St., Brooklyn, N. Y. The invention aims to provide a film reel which shall be entirely fireproof so that no possibility of an explosion occurring in the operator's booth. A further object is the provision of a film reel in which a film may be transported and be guarded against any accident, the end of the film readily attached to the securing means, and the provision of a structure which will make it possible to have free access to the interior of the reel at any time necessary.

CLOTH LAYING MACHINE.—M. ISAACS, 15 E. 17th St., New York, N. Y. The invention relates to a machine for piling cloth on the cutting tables in factories preparatory to marking and cutting. Among the principal objects are, to simplify the operation of the machine, to reduce the cost of construction, and to insure accuracy when piling the same on a table.

ATTACHMENT FOR TYPEWRITERS.—F. E. FANGER, Apartado 5138, Mexico, Mex. This invention relates to an attachment for typewriters whereby the user may know at any time and instantly how many lines may still be written on the unused portion of the paper inserted in the machine. The general object is to provide an indicating attachment which may be readily applied to standard typewriter machines in use or embodied in the machine at the factory.

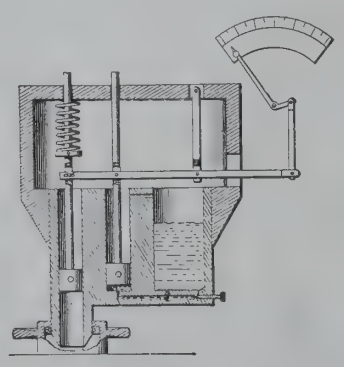
INDICATOR VALVE POST.—R. H. THORNE and F. J. MILLER, Williamsport, Pa. An object of the invention is to provide an indicator valve post wherein one legend bearing plate may be adjusted with respect to the other so that but one valve operating screw of the same pitch need be employed irrespective of the diameter of the valve in any of a number of indicator posts wherein the invention may be embodied.

### Musical Devices

PHONOGRAPH ATTACHMENT.—D. MCNEILL, Huntington, W. Va. The particular object of this invention is to suppress as far as possible the undesirable noises due to the mechanical scratching of the stylus upon the record disk or member equivalent thereto by dividing the sound waves into two parallel channels so arranged as to cause the undesirable sounds passing through one channel to interfere with those passing through the other and to neutralize to a considerable extent the acoustical effect of the two groups.

### Prime Movers and Their Accessories

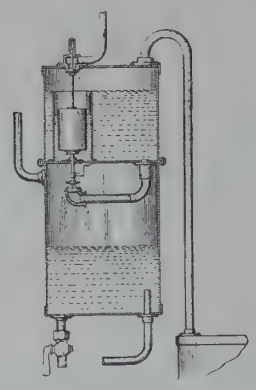
PRESSURE INDICATOR.—M. R. BUCHANAN, Silver City, N. M. This invention has for its object to provide an indicator of the character specified especially adapted for indicating the mean effective pressure in the cylinder


A SECTIONAL VIEW OF THE INDICATOR

of an internal combustion engine and to indicate the load that each cylinder is carrying in multiple cylinder engines to permit the load to be evenly balanced between the cylinders of the engine.

HYDROCARBON BURNER.—K. A. STAHLGREN, 131 Broadway, Newport, R. I. The object of the invention is to provide a hydrocarbon burner arranged to insure a thorough atomizing of the crude oil or other liquid hydrocarbon fuel, and to produce an effective mixing of the air and the atomized fuel to insure complete combustion thereby utilizing the liquid fuel to the fullest advantage. Another object is to insure the formation of a conical-shaped flame.

FUEL SUPPLY SYSTEM.—M. PARNES, 231 2nd Ave., New York, N. Y. This invention relates to fuel systems for internal combustion engines and it pertains more particularly to that type of system in which the operation is carried out by means of a partial vacuum.

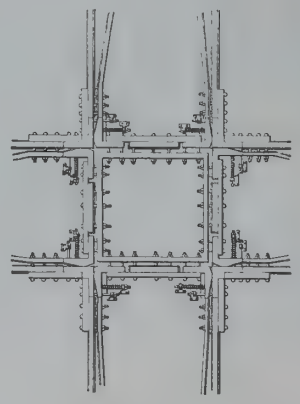

A VIEW WITH THE PARTS IN POSITION WHEN VACUUM IS CUT OFF

It is the prime object of the invention to supply the auxiliary receptacle with fuel from the main receptacle automatically by the creation of a partial vacuum within the auxiliary receptacle.

### Railways and Their Accessories

MEANS FOR PREVENTING CLOGGING OF SAND PIPES.—G. H. JOHNSON, address J. L. Taylor, Gulfport, Miss. The invention relates generally to sand pipes of steam as well as street railways, the primary object being the provision of simple inexpensive means to prevent the clogging of sand pipes, particularly at or adjacent to the discharge end of the pipe, where clogging commonly occurs. Another object is to provide an air supply attachment under control of the operator, to direct the sand exactly where it is desired in spite of the influence of the wind or other exterior force.

RAILROAD CROSSING.—J. P. HOUK, New Albany, Miss. This invention has for its object to provide a crossing wherein the shock and jar of the wheels crossing the space between the rails is eliminated, a bridge being


A PLAN VIEW OF THE CROSSING

provided normally spring held in position to support the crossing wheels, but arranged to be moved out of the way of a wheel coming at right angles.

### Pertaining to Recreation

TOY BAND WAGON.—C. H. BALKNAP, 323 Washington St., Brooklyn, N. Y. The object of the invention is to provide a toy wherein a combined wagon and music box is provided, arranged to operate independently or simultaneously. Another object is to provide a toy wagon provided with a talking machine and means for connecting the talking machine and wheels of the band wagon with the same driving motor.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## Reducing Trade Routes with Submarine Freighters

(*Continued from page 150*)

nevertheless be structurally so molded that she could sustain the hydrostatic pressure at a depth of 600 feet. The intention, however, is to restrict diving under working conditions to a maximum depth of not more than 300 feet. According to his calculations, Mr. Lake believes that he can build a ship of his special pattern with less material than the usual surface freighter of equal strength and carrying capacity, and he is convinced that his submarine would be cheaper to operate. Of course, his saving in structural weight is due to his adoption of a circular cross section wherever possible and in limiting to a marked degree the extent and mass of the steel work above water.

With her ballast tanks empty, the ship would have a displacement of about 9,000 tons, and the difference between this and the submerged displacement—4,000 tons—would represent reserve of buoyancy. This could be called into play to enable the boat to rise up through the ice by centering this effort along the rather narrow edges of the craft's "hog back." That is to say, it will be possible to drain the ballast tanks at a depth of 50 feet; and this suddenly applied buoyancy would produce an upward impulse of sufficient moment to lift and to shatter the ice in a direction in which it is least capable of resisting fracture. The upper line of the ridge or deck will be reinforced by a heavy steel rib, and this rib will merge with a very strong conning tower so shaped forward and aft that the ends will, in effect, constitute powerful ploughshares. Therefore, rotten ice or ice several feet thick can be broken and turned aside in a way to clear a channel for the conning tower to forge through. By inclining the bow slightly, with the submarine running at the surface in the awash condition, and then driving ahead, much of the ice encountered during the spring and summer can be smashed and scattered without resorting to total submergence. In this trim, the submergible freighter will remain in contact with the air and be able to use her main propelling plant, be that a steam or a Diesel engine. Mr. Lake is of the opinion that it would probably be unnecessary to submerge entirely except on rare occasions.

The scheme is not to provide short routes only between existing deep-sea ports. The aim is to open up to commerce regions that are now rather inaccessible and yet susceptible of contributing enormously to our stocks of raw materials, etc. For instance, northern Russia and Siberia cover an immense area rich in gold, silver, platinum, iron, coal, timber, and furs; and a portion of this part of the world is capable of yielding yearly many millions of bushels of wheat. There are three great rivers, each a good deal longer than the Mississippi, which drain this area and empty into the Arctic Ocean, where shipping points could be established.

Again, to bring the benefits nearer home, Mr. Lake proposes to use submergible freighters to tap northern Canada so as to provide a ready outlet for the wheat and other commodities of Manitoba and Saskatchewan. He would do this by way of Hudson Bay, which is usually open about six months a year, and thus save more than a thousand miles of the journey which these products have to make in reaching the Great Lakes and thence to the seaboard en route to Liverpool. Conditions in Hudson Bay which would be likely to interfere with or halt transportation in the usual types of steamers would not prevent the effective operating of cargo-carrying submarines. Each ship of the size already mentioned would be able to handle a load of 7,500 tons.

(*Continued on page 166*)

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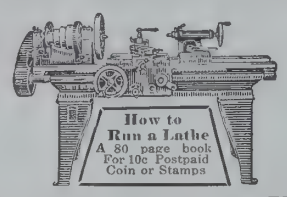


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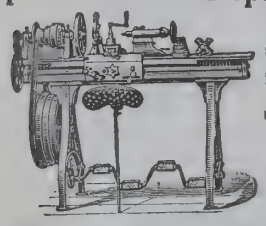

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## Reducing Trade Routes with Submarine Freighters

(*Continued from page 164*)

As Mr. Lake sees it, the under-water ship of trade has claims to consideration even beyond its peculiar fitness to navigate ice-strewn waters. He declares his submersible to be safer to run at all times and that it is practically unsinkable except at the will of those aboard. Despite the fanciful character of the project, it should be borne in mind that Mr. Lake has helped materially toward achievements commonly believed Utopian twenty-five years ago; and it is upon these accomplishments that he now confidently bases his contemplated revolution in deep-sea transportation.

## The Aquitania as an Oil Burner

(*Continued from page 151*)

in each watch, and the loss from this cause amounted to 8,000 horse-power every 4 hours. With oil firing there is a constant flow of oil; a constant furnace temperature; and contraction stresses, due to the inrush of cold air through the open fire doors, are avoided. The steam pressure is constant; the average speed is higher; and the life of the boilers is prolonged.

## What Is an Asphalt Road?

(*Continued from page 151*)

The second course or wearing surface consists of a mixture of hot asphalt, dust, and sand, mixed and rolled in the same way. The sand is finely graded so as to give great strength and stability, while the asphalt binds the whole together closely. The combined thickness of the two courses is usually two and a half or three inches.

Another type of pavement which is more and more widely used both for city streets, boulevards and country roads is the asphaltic concrete or Topeka type. This resembles the sheet asphalt type except that it is generally laid in one course two inches thick, and instead of consisting only of asphalt, dust, and sand, also contains a small proportion of small stone.

The most widely used pavement for country roads is the asphaltic macadam pavement. This is simply a broken stone or macadam road in which the stone is bound together with asphalt. The stone is laid in two courses and the asphalt is poured into it from a machine which distributes it under pressure; the asphalt penetrating the stone and binding it all firmly together. This kind of pavement is often referred to for that reason as a penetration macadam road.

Asphalt is produced from asphaltic petroleum. Petroleums differ very greatly in character according to the field where they are produced. The oils found in the Eastern and Middle Western States are known as paraffine petroleums, while those found in Texas, California, Mexico and South America are known as asphaltic petroleums.

## Electrification in Brazil

(*Continued from page 153*)

is that it gives increased track tonnage capacity by reason of heavier trains, higher speeds and reduction in the number of daily train movements. The other is that the cost of electrification in many cases that have been thoroughly investigated has been found to be considerably less than the cost of corresponding improvements with continued steam-engine operation, and that there is also a return upon the additional capital charge incurred for electrification of from 15 to 20 per cent, resulting from the savings in the operating expense over steam operation.

The eventual electrification plans of the Paulista Railway are for the complete electrification of the line from Jundiahy to Sao Carlos do Pinhal, comprising the greater portion of the main trunk line of the company. This is the second largest railway electrification project in the world, being only surpassed in magnitude by the electrification system on the mountain divisions of the Chicago, Milwaukee & St. Paul Railway in the United States. The St. Paul is electrically operated for a distance of 440 miles. The electrified portion of the road crosses the Rocky Mountains at an elevation of 6,350 feet, the Belt Mountains at an elevation of 5,768 feet and the Bitter Root Mountains at 4,200 feet. The road in these regions presents one of the most difficult problems of transcontinental railroading in the world. Practically all of the important features of that gigantic work will be incorporated in the Paulista electrification.

## Seeing in the Dark

(*Continued from page 154*)

however, the Germans were on the run and trench warfare had practically ceased. The menace of airplane raids, on the other hand, was increasing, and it was decided to develop a similar apparatus for ranging on airplanes. Anti-aircraft guns were rather a joke, insofar as actually hitting anything was concerned. The endeavor was to maintain a heavy barrage and keep the enemy high up so that he could not drop his bombs with accuracy. Sound horns were in use to locate invisible airplanes, and could do so with great accuracy, but unfortunately it took the sound 7 or 8 seconds to get down to the ground from the plane and the shell almost as long to get up there. Usually, by the time the shell arrived at the calculated place the plane was somewhere else. The great advantage of getting the range by heat radiation was that the indication traveled to the ground with the speed of light, almost instantly; in other words, there was no time lag.

Some successful tests were made with model airplanes, and the construction of special thermopiles and a special ranging instrument was at once started. The thermopiles for this work had to cover a much larger field than those for trench use, on account of the great speed of the planes. They were built in a form comparable to the cross hair of an ordinary optical instrument, and are probably the most elaborate thermopiles ever constructed.

This instrument was finished about the time of the armistice, and was tried out in January, 1919, at Langley Field, Virginia. No trouble was experienced in picking up planes a mile away, or in keeping the dark image on the thermopile. By keeping the image constantly on the pile, the speed of the plane could be read directly by the instruments already in use for daylight work. As extended night flying with poor landing fields was extremely dangerous no attempt was made to ascertain the maximum distance at which planes could be picked up. To allow for the low elevation of the plane used in the tests, the motor of a small, low-powered plane was throttled down so that it developed only about 50 hp. It was figured that this small amount of energy would be about equivalent to that coming from one of the large bombing planes at the usual great height. One instrument alone gave only the direction of the plane; two were necessary to give, by triangulation, the height.

The ease with which planes can be detected at night is largely due to this very cold indication of the clear sky. Anything coming in between the sky and the thermopile, either a plane or a cloud, acts as a shutter to cut off the radiation from the surface of the thermopile to outer space, and results in a large warm indication.

The fact that clouds lessened the value of this method of detecting planes at night is not of as much consequence as may appear at first sight. For obvious reasons, raids were very seldom attempted on any but clear nights.

It will be noticed that the original prob-


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iem, actual vision at night, had been entirely lost sight of. There was no compensating military advantage to be gained which would have justified the large amount of work entailed in developing such a device. Mere detection in the dark was ample for any military use. As regards the practicability of carrying this work to the point of vision at night, there should be no great difficulty in obtaining a perfect silhouette. It is simply a matter of multiplying the number of units involved. If any commercial use for such a device develops the solution is at hand, but until such a use is suggested it is hardly worth while to undergo the considerable expense of such a development.

## Harvesting the Hay the Latest Way

(*Continued from page 157*)

work much better than the smaller outfit, which requires the same supervision on the part of man. An even more efficient rake for use on large areas is the side-delivery rake, for it enables the hay loader to start taking the hay from the windrow as soon as the side-delivery rake has made one double windrow across the field.

On some farms where considerable hay is raised, it is the custom to bunch the hay by hand, but this is an expensive way compared with the method of bunching with a two-horse sulky rake. Such an outfit can bunch 30 or more acres per day, and a boy can do the work as well as a man.

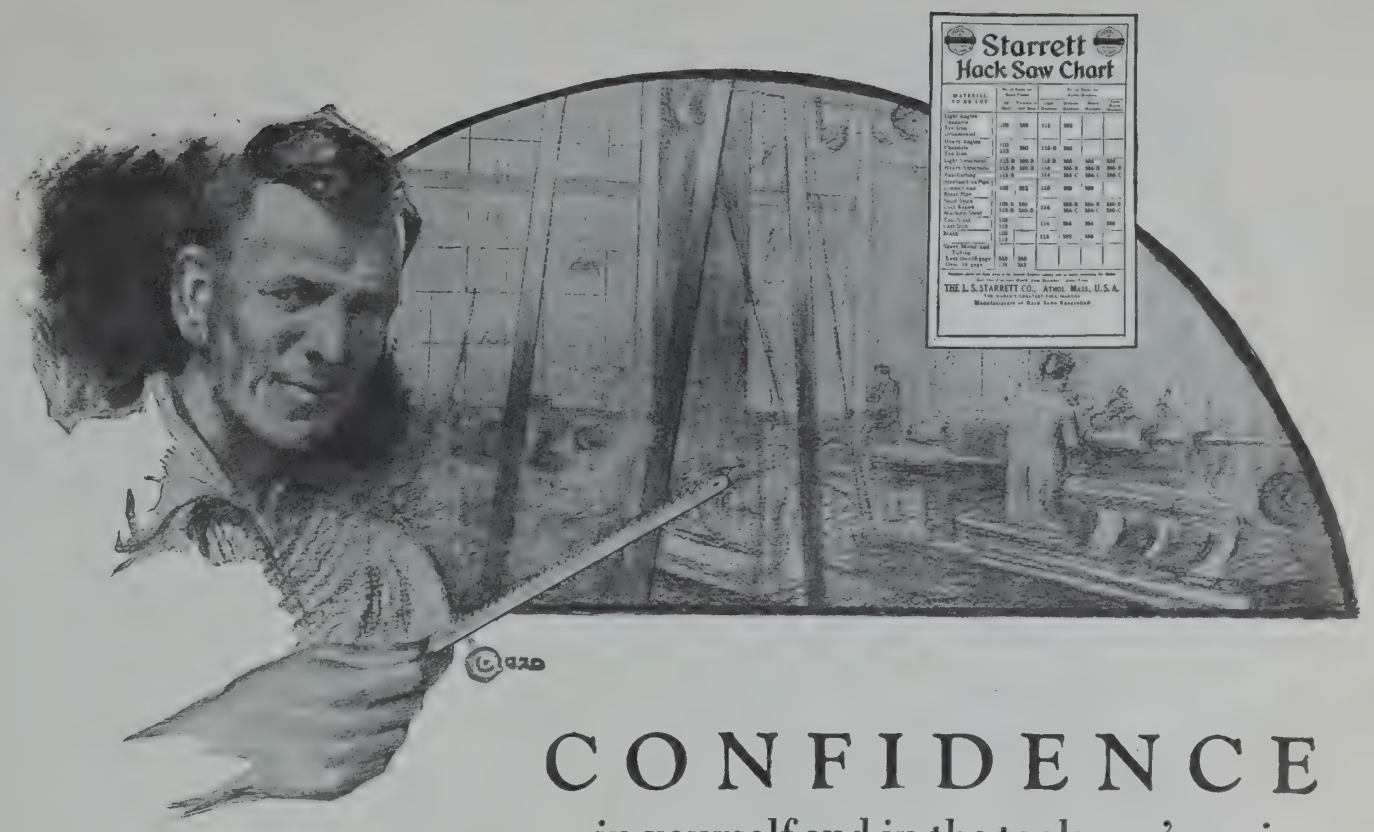
Out in the West, which is a section of "magnificent distances" and everything is done on a big scale, the haymakers have perfected a sweep-rake which reduces by about 50 per cent the labor requirement for harvesting hay, and this method is equally adapted to conditions in the East and South. It is comparatively inexpensive to build and costs little for repairs, and it eliminates a great deal of the irksome hand labor. With the sweep-rake a boy who can drive a team can do the same work as a man.

The sweep-rake consists of several long wooden teeth lying almost flat on the ground, pointed at one end and fastened to a strong framework at the other. The points are sometimes fitted with steel caps over the ends of the teeth and shaped so as to prevent them from running into the ground under ordinary conditions yet so as to slip under the hay, no matter whether lying in piles, windrows or swaths. The teeth usually are about 8 feet long and placed approximately 1 foot apart. The total width of the rake ordinarily is about 12 feet, containing 13 teeth. This gives a surface approximately 8 by 12 feet on which the hay can be loaded and carried.

In operation, the horses or tractor used for supplying power is hitched behind, and the rake is pushed forward gathering up the hay as it goes. The quantity of hay which can be loaded on a sweep depends somewhat on the condition the hay is in, but principally on the skill of the driver and the amount of power available from the horses or tractor. A skilful driver can carry a load of half a ton, and the use of the sweep-rake in large fields will prove very efficient. They are particularly valuable when it is necessary to rake up and stack hay in the field, when a heavy rainstorm threatens.

Another labor-saving device in haymaking that has been perfected in the West is the hay stacker. Where hay is stacked by hand the work is backbreaking and requires strong men, while with the use of the mechanical hay stacker boys can replace men for some of the operations.

Hay stackers are of two general types, according to the way they handle hay. One type has teeth on which it receives hay brought to it by push rakes, and the other handles the hay by means of the harpoon fork, grapple fork, or sling. The first type is represented chiefly by the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Taylor and other exponents of scientific management have taught us much regarding the efficiency of cutting tools and we have profited by it; but until Hack Saw practice was standardized by the establishment of the Starrett Hack Saw Chart, there was no definite basis for economic progress in this field.

### The Essentials of an Efficient Saw

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*a*—The blade must cut fast.

*b*—The blade must do the maximum amount of work at the minimum combined cost of the saw itself and the labor and overhead chargeable to the operation.

*c*—The blade must be suited for use on the largest variety of materials possible without interfering with "a" and "b."

### A Practical System of Blade Selection

Any system of blade selection to be really practical must be based wholly on the material to be cut, rather than on any classification of blades according to a list of trades or an arbitrary classification by number. Were it possible to say that in any particular trade only certain classes of material were cut, such a classification would be ideal; but dividing the metals according to their influences on cutting speed, saw life, etc., which is the only true basis to use, it is practically impossible to say that any given trade will have occasion to cut only a definite portion of the list. Efficiency is best served by classifying the various materials, the one group of factors with which every operator, skilled or unskilled, is familiar, and putting opposite the name of each metal the catalog number or designating letter of the saw which should be used. A copy of the Starrett chart will be sent free upon request.

# In "the good old days"—when meat was "cheap"

Years ago people were buying steaks and chops "cheap" and other meats in proportion.

It is true that meat prices are higher today—and so is the price of live stock.

But—

If present-day methods had been in use fifty years ago, meat would have cost our fathers and mothers and uncles and aunts even less than it did!

Many parts of the animal were actually thrown away; the business was done in small unsanitary plants.

As a matter of fact, meat was *not* cheap in the early days as compared with the price of live stock. See what U. S. Census figures show:

In 1870 it took nearly 19 per cent of the value of meat products to cover the packer's expenses and profits for turning animals into meat; the latest census shows that with modern methods it took less than 13 per cent of the value of meat products to perform this same service.

This smaller relative "spread" between live stock and meat prices is due to development of large scale operations and elimination of waste. It means that meats are cheaper today than they used to be, compared with the cost of raising live stock.

Out of all receipts from the sale of animal products last year, Swift & Company paid out over 85 per cent for the live animals. The other 15 per cent covered all plant, shipping, and selling expenses—and also the profit, which averaged only a fraction of a cent per pound on all products sold.

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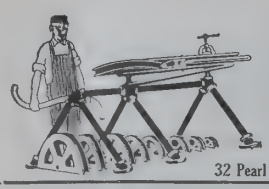

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"overshot" and the "swing-around" stacker. Each of these has long wooden teeth, like those of a push rake. The push rake drops its load of hay directly on these teeth. When the push rake is operated properly, there is no necessity for hand work, except that occasionally it may be necessary to gather up scattered hay with a fork when several push rakes are used. Two horses, or a tractor, are used to elevate the hay to the proper height to be dropped on the stack.

The second type, stackers that do not receive hay directly from push rakes, but handle it by means of horse forks or slings, are usually home-made stacking outfits, and there are a number of these. The cable stacker is one of the simplest and most generally used, and consists of an A-shaped frame higher than the hay stack to be built, to which is fastened a steel cable on which the carrier travels. The materials for such a stacker can be obtained on the farm or from any hardware store. The single-pole or derrick stacker is used to a considerable extent, and it consists of a single pole long enough to make a stack of the desired height, to which is fastened a shorter pole, or boom, at right angles. Three pulleys, about 100 feet of rope, and a horse fork complete the outfit. Where a number of stacks are to be built, it is customary to mount the pole on wheels or on runners, which can be easily moved. The pole is supported by three or four guy ropes or wires.

In what is known as the "Black Belt" in Georgia, Alabama and Mississippi, there has been developed a successful type of truck for curing hay. In this section the principal kinds of hay grown for market are alfalfa, Johnson grass, and alfalfa and Johnson grass mixed. The hay-making season covers a period of several months, and from three to five cuttings are obtained per year. The great drawback in producing hay, however, is the difficulty in curing the hay during unfavorable weather. The hay-curing truck was designed to enable the grower to cure hay during rainy or cloudy spells of weather when all ordinary methods of curing in the field failed.

The curing truck is a device which supports hay during the curing process, protecting it from rain and from moisture in the ground. It requires no more man labor or horse labor for loading, unloading or hauling than do the more familiar methods of curing.

The truck is quite similar to the ordinary hayrake. It is 12 feet long and 7 feet wide and will hold from 1,500 to 2,000 pounds of cured hay, depending on how much the hay is cured when put on the truck. The back is supported by two 16 to 20-inch steel or iron wheels running on an axle placed about 4 feet from the rear end of an A-shaped frame. When a loaded truck is not in motion, as when left in the field for the hay to cure or while it is waiting to be baled, the front end is supported by a 6 by 8-inch wooden block or "trigger" of sufficient length to hold the truck level. This trigger is fastened between the two main frame timbers by a heavy bolt, enough play being left so that it swings easily by its own weight. When the trigger is not in use the free end, pointing to the rear, drags lightly on the ground. The trucks are moved by means of a two-horse team and by reason of their being moved from place to place, the hay can be either left out in the open on bright days or placed under shelter in times of storm. A canvas covering will protect the hay from the top, and the hay being off the ground, will prevent being spoiled by excessive ground moisture.

## The Racing Airplane of the Future

(*Continued from page 158*)

will be built also of thin sheet metal, and will be generally elliptical in cross section; two very light trusses, one horizontal, the other vertical, extending from the operator to near the tail. The chords of these trusses will be formed of light T-iron.

To provide for the heavy loads and stresses that are concentrated at the wings and motor, the T-irons of the trusses will be increased in depth and run entirely around the forward end of the body, forming, at their intersection in the nose, a strong construction for carrying the motor. Additional strength will be provided by transverse diaphragms. It is understood, of course, that all of this metal work will be specially rolled in extremely light sections, and that the material will be some alloy, such as vanadium steel, which in experimental specimens, as noted on our editorial page, has shown elastic limits running up to over 200,000 pounds to the square inch. The motor of from 75 to 150 horse-power, according to the size of the airplane, will probably be of the revolving type; the Gnome motor having shown itself to be the ideal airplane drive.

Turning to nature for guidance again, we find that the fast-flying birds fold their legs snugly beneath them when in flight. The racing airplane must do the same. We show a suggested arrangement for a folding chassis, hinged just below the body, and provided with a yoke which leads from the axle up to the crosshead of a piston rod, which, with the guides and cylinder, is carried by the T-iron that forms the bottom member of the vertical truss. The cylinder is provided with a two-way valve and connections by which compressed air can be introduced to the forward or after end of the cylinder. When the chassis is down and in operation, the compressed air acts as a cushion to provide a certain amount of fore and aft movement to the wheels. As soon as the machine rises, a throw of the valve introduces compressed air at the forward end of the cylinder, and the chassis is drawn up snugly against the body. A small tank of compressed air, which supplies the folding mechanism, also supplies a small cylinder of similar construction placed transversely to the car, which operates the movable wing tips. The two-way valve of this cylinder is controlled by a small gyroscope, which may be thrown out of gear when the airman wishes to make a turn, or perform other evolutions.

In answer to the question as to what speed may be expected from a machine of this general design, we think it will be agreed that, in view of its sweetness of form, the complete absence of wires, struts and other energy-consuming surfaces, and the fact that because of the smoothness of the steel surface, skin friction will be reduced to a minimum—it is conservative to expect from such a machine, after it has been developed by experimental work, speeds of from 100 to 125 miles an hour.

It would be interesting to see what Mr. Herreshoff could accomplish, if he applied to the steel airplane the same constructive genius which enabled him to produce such fine results with steel racing yachts.

## Helmets and Body Armor in Modern Warfare

(*Continued from page 159*)

seded the "porridge bowl" English helmet. It was made of manganese steel, and it has the advantage over the old type that it protects the back and sides of the head better than the earlier model.

We show also an American experimental back plate which is laminated. It is made up of a large upper plate, two intermediate pieces, and a lower-most plate, or *garde reins*. These elements are riveted together and are made interflexible by the use of slotted grooves in which the rivets can travel, as in the old-fashioned "alemayne rivets." The back plate is made to suit wearers of many sizes, and it is cushioned with sponge rubber that serves to protect the wearer against injuries from indentation of the metal. It will stop a bullet traveling at 1,000 feet per second.

IN THIS ISSUE:

IS THERE A COAL SHORTAGE?
AN ENGINEERING BULWARK

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

THE LARGEST OF ITS KIND: 350-TON CRANE AT PHILADELPHIA NAVY YARD.—[See page 178]

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# FIVE OIL MISTAKES

## *How to stop maintenance dollars from blowing through the exhaust*

MOTORISTS are looking for scientific ways to reduce upkeep. Old mistakes—always costly—today positively extravagant—must go.

Here are five common lubrication errors. They are responsible for many of the operating troubles that motorists experience.

### MISTAKE No. 1

***"Oil is a good thing —you can't have too much of it."***

Some motorists believe that if the oil reservoir is filled above the indicated high level, better lubrication will be provided. They are mistaken. Oil should be kept at the proper level —no higher. Over-filling causes excessive carbon, gummed valve stems and sooty spark-plugs.

### MISTAKE No. 2

***"I use heavier oil because my engine's badly worn."***

Many motorists believe that a change to heavier oil is advisable in a worn engine. This is not so. Worn engines need *overhauling*. Heavier oil is no substitute for worn parts. The lubrication system of a car may be wholly unsuited to properly distribute a heavier oil than specified in our Chart of Recommendations.

### MISTAKE No. 3

***"Old oil never does any harm in the crank-case."***

Some motorists neglect to drain the old oil from the crank-cases of their engines at frequent intervals. The correct oil is not destroyed in use. But it does become contaminated with grit drawn in through the breather, with carbon particles from the undersides of the pistons and with water from condensation. It also becomes thinned out with fuel absorbed by the oil film on the cylinder walls, especially when the mixture is too rich. For these reasons old oil should be drained from the crank-case frequently.

### MISTAKE No. 4

***"When refilling I always clean out my engine crank-case with kerosene.***

This procedure sounds logical—hence has come into common use. Experience shows, however, that it is almost always a mistake, for some of the kerosene is usually retained in the splash troughs or other oil pockets in most crank-cases and thus thins out the new oil. The better plan is to drain the crank-case when the engine is hot. This will carry off the sediment before it settles. Then flush out with a quart of fresh oil and refill to the correct level.

### MISTAKE No. 5

***"My oil seems to work all right."***

This, perhaps, is the grandfather of all lubrication mistakes. "My oil seems to work all right" sends more cars to the repair shop than all other causes combined.

The motorist cannot watch from day to day the inside of his engine Hence he is in no position to know accurately the effects of different oils. While many oils may "seem to work all right," only *one* of those oils may be giving him scientific lubrication. And only that *one* can give him —the lowest fuel bills, the lowest oil bills and the lowest repair bills.

The Chart at the right specifies the grade of Gargoyle Mobiloils which is scientifically correct for *your* car.

The use of that oil and the avoidance of the common mistakes mentioned here will show you *engine results*—economy and power—which you may never have had before.

GARGOYLE

# Mobiloils

*A grade for each type of Motor*

***Domestic Branches:***

**New York** **Boston** **Philadelphia** **Pittsburgh** **Detroit** **Chicago** **Minneapolis** **Indianapolis** **Kansas City, Kan.** **Des Moines**

## Chart of Recommendations *for* AUTOMOBILES

(Abbreviated Edition)

GARGOYLE

# Mobiloils

*A grade for each type of motor*

### How to Read the Chart

THE Correct Grades of Gargoyle Mobiloils for engine lubrication are specified in the Chart below

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

**These recommendations cover all models of both passenger and commercial vehicles unless otherwise specified.**

Where different grades of Gargoyle Mobiloils are recommended for summer and winter use, the winter recommendation should be followed during the entire period when freezing temperatures may be experienced.

This Chart is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and constitutes a scientific guide to Correct Automobile Lubrication.

If your car is not listed in this partial chart, consult the Chart of Recommendations at your dealer's, or send for booklet, "Correct Lubrication," which lists the Correct Grades for *all* cars.

| NAMES OF AUTOMOBILES AND MOTOR TRUCKS | 1920 | | 1919 | | 1918 | | 1917 | | 1916 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| Allen | A | Arc. | A | Arc. | Arc. | A | Arc. | A | A | Arc. |
| Anderson | | | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Armleder (1 ton) | A | A | | | | | | | | |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Auburn (4 cylinder & 6-38) | | | | | | A | Arc. | A | A | Arc. |
| " (6 cylinder) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " (6-39 B) (Teetor-H Eng.) | | | | A | Arc. | | | | | |
| Buick | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Cadillac | A | A | A | A | A | A | A | A | A | A |
| Chalmers (6-48) | | | | | | | | | Arc. | Arc. |
| " (6-40) | | | | | | | | | A | Arc. |
| " All Other Models | A | A | A | A | A | A | A | A | A | A |
| Chandler Six | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Chevrolet (8 cylinder) | | | A | A | A | A | A | | | |
| " (F. A.) | | | A | Arc. | A | Arc. | | | | |
| " (F. B. & 1 ton) | A | Arc. | | | | | | | | |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Cleveland | A | Arc. | | | | | | | | |
| Clydesdale (120 B) | A | A | A | A | | | | | | |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Cole (6 cylinder) | | | | | | | | | Arc. | Arc. |
| " (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Cunningham | A | A | A | A | A | A | A | A | A | A |
| Dodge Brothers | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Elgin | A | Arc. | | | A | Arc. | A | Arc. | A | Arc. |
| Essex | A | Arc. | A | Arc. | | | | | | |
| Federal (Model S-30) | | | | | | A | A | A | | |
| " (Special) | | | | | | Arc. | Arc. | | | |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | A | A | Arc. | Arc. | Arc. | Arc. |
| Ford | E | E | E | E | E | E | E | E | E | E |
| Franklin | A | A | A | A | A | A | A | A | A | A |
| Garford (3½, 5 & 6 tons) | A | A | A | A | A | A | A | A | A | A |
| " All Other Models | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Grant (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (Com.) (Model 12) | | | A | Arc. | | | | | | |
| " ( " ) All Other Models | Arc. | Arc. | Arc. | Arc. | | | | | | |
| Haynes (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (12 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Holmes | B | A | | | | | | | | |
| Hudson Super Six | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | A |
| " All Other Models | | | | | | | | | Arc. | Arc. |
| Hupmobile | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Jordan | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | | |
| Jumbo | A | A | A | A | A | A | | | | |
| King (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Kissel Kar (Model 48) | | | | | | | | | A | A |
| " " (12 cylinder) | | | | | A | A | A | A | | |
| " " All Other Models | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Kline Kar | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Lexington | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Liberty | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | | | |
| Locomobile | A | E | A | E | A | E | E | E | E | E |
| Mack (Models AB & AC) | A | Arc. | A | A | A | A | A | A | A | A |
| " All Other Models | | | | | | | | | A | E |
| Maibohm | A | Arc. | A | Arc. | A | Arc. | A | Arc. | | |
| Marmon | A | A | A | A | A | A | A | A | A | A |
| Marwell | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Mercer | A | A | A | A | A | A | A | A | A | A |
| Mitchell (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (8-cylinder) | | | | | | | | | A | A |
| Moline-Knight | | | B | A | B | A | A | A | A | A |
| Moon | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Nash (Quad) | A | A | A | A | A | A | | | | |
| " (Model 671) | | | | | A | A | | | | |
| " All Other Models | A | Arc. | A | Arc. | A | Arc. | | | | |
| National (6 cylinder) | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. |
| " (12 cylinder) | | | A | A | A | A | A | A | A | A |
| Nelson | A | A | A | A | A | A | A | A | | |
| Oakland (8 cylinder) | | | | | | | | | A | A |
| " All Other Models | A | A | A | A | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Oldsmobile (4 cylinder) | A | Arc. | A | Arc. | | | | | Arc. | Arc. |
| " (6 cylinder) | A | A | A | A | A | Arc. | Arc. | | | |
| " (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Overland | | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Owen Magnetic (Model M-25) | | | | | Arc. | Arc. | Arc. | Arc. | | |
| " " All Other Models | A | A | A | A | A | Arc. | A | Arc. | A | Arc. |
| Packard | A | A | A | A | A | A | A | A | A | A |
| Paige (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (Cont. Eng.) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " All Other Models | A | A | | | | | | | | |
| Peerless (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| " All Other Models | | | | | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Pierce Arrow | A | A | A | A | A | A | A | A | A | A |
| " " (Com.) (5 ton) | A | A | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " " " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Premier | A | A | A | A | A | A | A | A | A | Arc. |
| R. & V. Knight | B | A | | | | | | | | |
| Rainier (1½ ton) | Arc. | Arc. | Arc. | Arc. | | | | | | |
| " All Other Models | Arc. | Arc. | A | Arc. | A | Arc. | A | Arc. | | |
| Reo | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Riker | A | E | A | E | A | E | E | E | | |
| Rock Falls | A | Arc. | A | Arc. | | | | | | |
| Saxon | | | E | E | E | E | E | E | E | E |
| Scripps-Booth (4 cylinder) | | | | | Arc. | Arc. | A | Arc. | A | Arc. |
| " (6 & 8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Standard Six | | | | | | | | | A | Arc. |
| " (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Stearns-Knight | B | A | B | A | B | A | A | B | A | |
| Stewart (Buffalo) | | | | | | | | | Arc. | Arc. |
| " " (Com.) (¾ ton) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " " ( " ) (1 ton) | Arc. | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " " ( " ) All Other Mod. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| Studebaker | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Stutz | A | A | A | A | A | A | A | A | A | A |
| Templar | A | A | A | A | A | A | | | | |
| Velie (Model 34) | A | Arc. | | | | | | | | |
| " (6 cylinder) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " (Com.) (¾ ton) | | | A | Arc. | | A | Arc. | | | |
| " " ( " ) All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | | | | |
| Ward La France | A | A | Arc. | Arc. | | | | | | |
| Westcott | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| White (16 valve) | | | A | A | A | A | A | | | |
| " (3 ton) | | | A | A | Arc. | Arc. | | | | |
| " All Other Models | | | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Willys-Knight | B | A | B | A | B | A | A | A | B | A |
| Willys Six | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | | |
| Winton | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |

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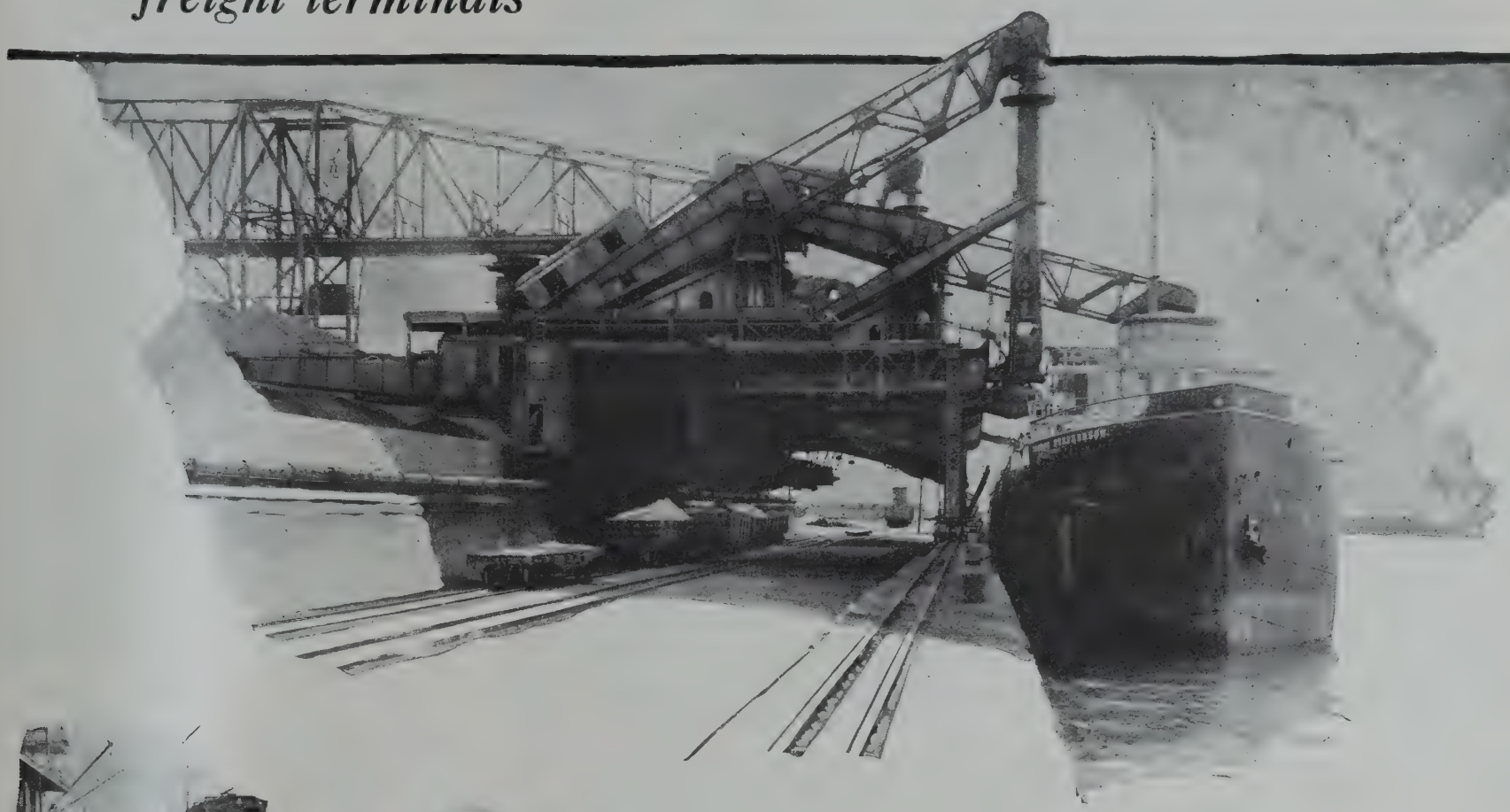
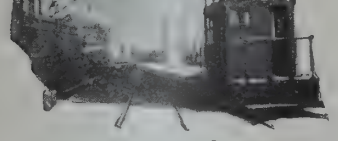
*The immediate solution of material handling problems is essential to the efficient development of marine and inland freight terminals*

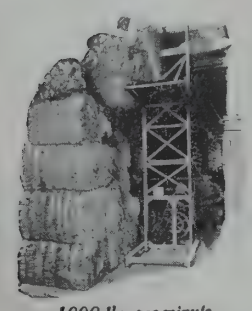




*Trolley Type Surface Locomotive works fast between ship and warehouse*

*Portable Elevator handling a ton a minute*

*Tractor and Trailers speed production*



*1000 lbs. per minute lifted from 30 to 50 feet in height*

*Storage Battery Locomotive hauling 50 tons of copper plates*

## *How electricity improves terminal facilities*

THE science of building great ships is not without a parallel science of building equipment to load and unload them. Today, when a big ship docks, a giant power quickly gets under way to clear the hold—this power is electricity applied to large and small material handling devices.

Unloading ore at the rate of fifteen tons per minute is the way the Hulett unloader works for one dock company. For loading and unloading cargoes at ports, the electric crane and hoist prove to be the most economical, most flexible, and most rapid of all machinery. For short distance moving of material, the electric conveyor speeds the work.

Where goods have to be moved greater distances along piers or in warehouses, the storage battery tractor and trailers make quick headway—and portable elevators stack high, neat piles in fast time. In the yards of big industries, electric locomotives simplify transportation problems.

All these devices, electrically equipped and controlled, are busy and consistent factors in conserving hours, and eliminating congestion in handling the world's goods.

Your needs of material handling equipment can best be filled by the manufacturer who, in building his product, obtains the specialized electrical experience and products of the General Electric Company.

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

43-502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# Putting horse-power over the jumps

THE blasting heat that most of us have felt as a boiler fire door is opened is cool compared to the white hot gases further in, that rise from the incandescent fire bed to be sucked back through the boiler and to the stack.

Their rush is swift, but before they can reach the stack, they have been forced to take the longest and most devious path through great racks of water-filled tubes, so that the water in the tubes will have every possible opportunity to absorb the heat from the gases.

To force them to take this longest path through the boiler, hurdles have been devised by engineers, over which this plunging flood of heat, energy, horse-power, must go, over and under, and up and down.

These hurdles, or baffle walls, as they are called, once presented many difficulties from a structural standpoint. They obviously must withstand great heat. They must be flame-tight, even though necessarily pierced and honeycombed by hundreds of tubes that change size as they heat or cool.

Johns-Manville has introduced a new departure in baffle construction, that of pouring the wall around the tubes just as concrete is poured.

Such baffle walls are really leak-proof and resistant to high furnace temperatures, and unaffected by contraction and expansion of the tubes passing through them. They make new fuel economies possible in steam boiler operation.

This is but one of the many departments of Johns-Manville Engineering in the great cause of power saving. In addition to Baffle Walls, a complete line of *High Temperature Cements* has been developed to protect boiler fireboxes, retorts, cupolas, and dryers, from destruction by high heats.

For the prevention of air leakage or infiltration there are other materials to be applied to the outside of boiler settings—all a most vital work in the conservation of fuel.

**Here are a few Johns-Manville products:**

*Monolithic Baffle Walls*
*Refractory Cements*
*Asbestos Insulating Cements*
*Asbesto-Sponge Felted Pipe Insulation*
*Asbesto-Sponge Felted Sheet and Block Insulation*
*85% Magnesia Pipe Insulation*
*85% Magnesia Block Insulation*
*Built-Up Brine and Ammonia Insulation*
*Cold Water Pipe Insulation*
*Vitribestos Stack and Breeching Lining*
*Steam Traps*

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***10 Factories—Branches in 64 Large Cities***

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*Through—*

**Asbestos**
and its allied products

INSULATION
*that keeps the heat where it belongs*
CEMENTS
*that make boiler walls leak-proof*
ROOFINGS
*that cut down fire risks*
PACKINGS
*that save power waste*
LININGS
*that make brakes safe*
FIRE PREVENTION PRODUCTS

# JOHNS-MANVILLE
## Serves in Conservation

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 8 ] NEW YORK, AUGUST 21, 1920 [ 15 CENTS A COPY 20 CENTS IN CANADA

## Emptying Eight Freight Cars into a Thimble

PICTURESQUE Long Park Plateau, in the Paradox Valley, Colorado, is the location of the group of radium luminous material claims which are steadily producing tons of radium-bearing carnotite. The nearest railroad is 58 miles distant, a trip of three and a half days for the six-horse wagons over rugged country, too rough for even light motor trucks.

Starting east with 250 tons of carnotite, a few weeks' production at the Long Park mines, filling 8 freight cars, the ore travels 2,600 miles through Denver, Chicago and New York, until the cars are finally unloaded at the main radium luminous material plants in Orange, New Jersey.

Scientific knowledge and infinite patience reduce that tremendous bulk of 250 tons of ore to scarcely a *thimbleful* of radium, Three distinct plants and hundreds of processes make possible the final desired reduction—*one gram* of radium element.

It seems inconceivable that a gram, which is approximately *1/28* of an ounce, can be worth $120,000. Yet this is true of radium and when one realizes that that tiny amount of radium combined with 20,000 grams of the secret process phosphorescent zinc sulfide results in sufficient radium luminous material to self-light for life *667,000* watches or clocks, the true value of radium to modern society is apparent.

In other words, one gram of radium plus 20,000 grams of zinc sulfide equals enough radium luminous material to self-light the time piece of every male adult in the City of New York.

All of which is interesting in view of the fact that the State of New York has recently purchased two and a quarter grams of radium, the largest commercial transaction of its kind ever made and the first purchase of radium by any State for a purpose of social utility. The 1920 State Legislature voted an appropriation of $225,000 for the purchase of the radium. The reason why this rather imposing sum does not go very far in the purchase of radium is as stated above; but perhaps it will be a little more clear if we consider the direct visual appeal of the drawings herewith.

The radium is to be used for research work in behalf of the New York State Institute for Malignant Disease, under the direction of Dr. H. R. Gaylord and his staff in Buffalo. The first shipment of one gram—about one-thirtieth part of an ounce, was delivered to a representative of the Institute in a lead cylinder eight inches in diameter and a foot long. The Bureau of Standards tested the radium and certified as to its weight and purity.

**These graphic comparisons tell why a gram of radium sells for $120,000**

## No Relation Between Cultivation and Rainfall

CAREFUL scientific records kept by the National Weather Bureau for more than a half century show irrefutably that the time-honored theory that the cultivation of semi-arid land increases the amount of rainfall in that region is wholly incorrect. During the period under discussion a decided increase in the area of cultivated land is noteworthy in the Great Plains States and yet there has been no definite and permanent increase in the precipitation records of that section of the country. The rainfall reports of Uncle Sam's scientists show that during the period from 1868 to 1892 inclusive the average precipitation for the Great Plains States was 19.25 inches while for the period from 1893 to 1919 the average rainfall was only 18.58 inches despite that the acreage of tilled crops increased very appreciably during the latter interval.

Furthermore it has been conclusively demonstrated the wet years and dry years do not occur—as popularly believed—in periods of two to three years each. There is no regular or routine occurrence of these times of drought or abundant precipitation. Sometimes the dry years come during wet periods or vice versa. It is not possible to predict potential precipitation from past records. A wet year may be followed by a very wet one or a dry year may succeed another dry one as the case may be. However, years of abundant and well distributed rainfall encourage a western extension of the cultivated area, and when a succession of favorable seasons occurs the farming operations are pushed much farther west into regions which ordinarily do not provide anywhere near enough moisture for profitable crop production. The following season may be a dry one and the boundary line for cropping activities may again be carried far eastward of its previous location. The rainfall of the Great Plains section varies considerably from one season to another but its vagaries are, in no respect, due to the increase or diminution in the area of tilled crops planted and harvested.

## Protection of Steel from Rusting by Painting

SOME useful notes on the protection of steel structural work from rust by means of painting are given by J. H. Shean in the *Canadian Engineer*. According to the author, the first coat of paint laid on the well-cleaned steel-work is of great importance from the point of view of rust prevention. The most generally accepted "inhibitive" pigment is red lead. It is now possible to buy red lead containing only 2 per cent of litharge (which in excess causes the troubles associated with this pigment) and 98 per cent true lead, PbO. This makes an ideal paint for a first coat. Being extremely fine it fills all pores and brushes out in a smooth, even film, free from voids. It stays in place on vertical surfaces, and does not act ropy under the brush. The vehicle with which the lead is mixed is fully as important as the pigment itself. The merit of linseed oil is well known, although the paint film is much better if reinforced with Japan oil. Japan oil, besides reinforcing the oil film against shrinkage, furnishes sufficient driers of the right kind. The amount of red lead to be used in one gallon of vehicle is a question on which engineers differ, the general average for railroad use being about 25 pounds to the gallon.

The usual dark aftercoats are probably all good if applied rightly, but the fact remains that they are all heat attractors. Unless the price of material is the main consideration, there is no reason why steelwork should not be painted in light colors and their resistance to heat rays would certainly be easier on the oil film which holds the pigment together than the dark colors which attract and hold the heat rays. The light colors will last sufficiently longer than dark colors to pay any extra expense. It may be argued that light colors become unsightly in a short time from dirt and smoke. This cannot be noticed to any extent except overhead on through truss bridges and overhead bridges on which even if painted black smoke marks show.

It would appear from this rather detailed discussion of the scientific aspects of what has usually been looked upon as a commonplace to be settled by the rule of thumb or the buyer's whim, that it will indeed be a paying proposition to subject the painter's materials and technique to thorough scrutiny.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Modernizing the North River Waterfront

THE agitation in favor of a thorough reconstruction of the facilities of the Port of New York has shown its first fruits in the plans of the Department of Docks for a complete rebuilding of thirty-two piers extending north from Vesey Street on the Manhattan waterfront of the Hudson River. Credit for this extensive work is due to Dock Commissioner Murray Hulbert, who is now abroad for the purpose of studying the up-to-date facilities of the leading ports of Great Britain and the Continent. Briefly stated, the plan contemplates the removal of thirty-two of the present narrow piers, with their inadequate slips and the construction, in their place, of eighteen modern piers, with wide slips between them, capable of accommodating the largest vessels.

Every one who is familiar with conditions at this port has known that our pier system was antiquated; and that portion of the recent report of the Dock Commissioner which deals with the history of this stretch of the Hudson River pier system reveals how antiquated it is, and gives some very interesting data as to its inception and subsequent development.

We are told that up to the year 1830 the shore along the North River consisted of a series of beaches, with occasional landing platforms built out over them. The commerce of the city was carried in sailing vessels, which were moored in deep water, the freight being transferred between ship and landing stage by small boats. Then the citizens who owned waterfront grants where the water was sufficiently deep, began bulkheading their properties so that vessels could lie alongside and discharge and load direct to shore; and it was this work that marked the beginnings of what is now known as West Street. The next development came in 1857, when the Board of Aldermen began to bulkhead the shore and build piers; and thereafter no private owner was permitted to build piers without permission of the city authorities.

Shortly after the Civil War, the need for a comprehensive plan was felt, and in 1870 the first Board of Docks was created, and Gen. George B. McClellan, as its chief engineer, drew up the plan of 1871, which provided, between Vesey and Perry Streets, a continuous bulkhead line, with a pierhead line 600 feet out in the river. Piers not over 600 feet in length were located at definite locations. The traffic requirements of that day and the future were believed to be amply met by making these piers from 40 to 60 feet wide, with slips between them of from 100 to 150 feet. Many of those piers are in existence today.

Now McClellan was a capable engineer and we may be sure that both he and the civic bodies in consultation with which he worked believed that in this, the first comprehensive layout of the Manhattan waterfront, they were making ample provision for future developments, both as to the size of ships and the magnitude of the traffic to be handled.

It would be unjust to the city fathers of that day to say that they were lacking in vision; rather, the present congestion is to be blamed upon the city administrations of a later day for failing twenty-five years ago to at least commence the reconstruction which is now to be undertaken after a lapse of fifty years.

The moral of the whole thing is obvious. When Commissioner Hulbert returns he should subject even the present plan to mature consideration, based upon the data he has gathered in Europe where piers of from 300 to 500 feet width are common. Furthermore, any plan for improving the North River waterfront should be worked out with a view to its coöperation with the double-deck elevated railway, which will ultimately be built from the North River Bridge at Fifty-ninth Street to the Battery.

We are gratified to note that the plans for the new piers provide for a 30-foot apron at the side of the piers for railway tracks which will be spanned by gantry cranes. This is in line with the latest practice, and it will add immensely to the rapidity of turn-around of the ships that lie at these piers.

## Double-Decking a Cure for Street Congestion

PROBABLY there was never a time in the history of this city when the matter of congestion of our city streets and the remedies therefor received so much attention as it does today. The files of the SCIENTIFIC AMERICAN show that many decades ago plans were being suggested for getting rid of the congestion which even then was felt to be intolerable. But conditions that were intolerable then would today be welcomed as a positive relief in some of our more crowded centers on Fifth Avenue and downtown.

Of all the suggested plans for relief, none would be so immediately effective as the double-decking of a few of our most congested arteries of travel. We have always strongly advocated this plan, in favor of which everything can be said and against which there is no serious objection. The double-decking of a street would immediately double and more than double its capacity, since it would not only double the number of foot passengers and vehicles that could comfortably make use of it, but, because of the greater fluidity of this traffic there would be a resulting increase in the number of people and vehicles that could pass a given point in any period of time on each level.

The city of Chicago is satisfied that double-decking is practical, and it is going to carry out a work of this character in what is known as the South Water Street improvement, which will extend for several blocks, or about 3,500 feet, along South Water Street. Several purposes are to be served, the first of which is to secure a new east and west thoroughfare on the margin of the well known "loop," the central business district of Chicago, which will serve as a by-path for heavy traffic which now crosses the route. Also, it will avoid interference of east and west trucking traffic with normal north and south traffic over the river bridges. Fronting on the river it will naturally provide freight handling facilities; and also, in addition to separating the fast and slow traffic and increasing traffic capacity, there are certain auxiliary advantages secured in the way of providing parking accommodations for automobiles, and the facilitating of the delivery of freight to adjacent buildings on two levels.

All heavy motor trucks, trolley and horse-drawn vehicles would be confined to the lower level, the upper deck being reserved for light motor trucks and automobiles. The absence of tracks would make it possible to utilize the center of the upper roadway for the parking of automobiles—an arrangement which would greatly increase the number of people who use their machines to reach their business offices. The upper deck would extend down the crosstown streets at the more congested centers; elsewhere, access would be had by means of inclines. These would be less than half the width of the side streets; the ramps for downtown traffic leading west and those for uptown traffic to the east.

Now all of these advantages, with the exception of those pertaining to river frontage, would be secured if the same method of double-decking were applied at some of our most congested centers, say on Broadway, Fifth Avenue and certain of the crosstown streets. By judicious coöperation of the engineer and the architect, the upper deck could be so laid out as to avoid the unsightly constructions which form our elevated railroads. An obvious suggestion looking to this end would be to build the supporting columns and floor beams in a series of flat arches and encase the whole in white glazed terra cotta. For lighting the lower deck or street level, it would be sufficient to reserve the upper deck for light automobile traffic and fill in the floor from curb to curb with a heavy design of skylight construction, similar to that now used on passenger sidewalks. Heavy trucking would be relegated to the lower deck at street level. An incidental advantage of this system would be that the store frontage along the street would at once be doubled, since property owners would readily appreciate the advantage of having additional window display on the second floor. Another and very practical advantage would be that the lower deck would afford a completely sheltered thoroughfare in rainy weather and during the snows and frosts in the winter time.

## Our Share of the Surrendered German Ships

IT was difficult to realize that the five rusty and unkempt ships, the battleship "Ostfriesland," the fast cruiser "Frankfurt," and three destroyers, as they made their way slowly into New York harbor, were once among the finest representatives of their respective types in the German navy. In their war-and-weather-worn condition could be read the tragic history of the German navy since the battle of Jutland; for to the scars of that battle have been added the neglect of several years of inactivity in German ports. and the marks of long submersion beneath the waters and in the mud of Scapa Flow.

The question has been frequently asked as to what disposition will now be made of these ships. So far as the inclusion of any of them in our Navy is concerned, it may be stated at once that, though they came into harbor flying our flag, none of them will ever go into active commission—this for the reason that the terms of their award to the United States by the Allied Naval Commission, after they had been surrendered under the Versailles Treaty, provide that they must be destroyed within one year.

The tentative plans of the Navy Department contemplate the exhibition of the battleship "Ostfriesland" in a few of the leading ports of the country, after which, in accordance with our engagement, the five vessels will be destroyed. Previous to that, however, a thorough study of their hull construction and armor plan and of their engines will be made by representatives of the Bureaus of Construction, Engineering and Ordnance. After that the "Ostfriesland," at least, will be allocated to a service in which she will prove to be of the greatest value to the Navy. She will be used for target practice and gradually shot to pieces for the sake of the invaluable lessons which can thus be learned. It will be remembered that one of our early battleships, the "Texas," renamed the "San Marcos," was used for the same purpose.

What renders the "Ostfriesland" of such great value as a target is the fact that the Germans paid particular attention to the protective elements in their battleships, and that they probably put a larger percentage of the displacement of their ships into deck and side armor than any other contemporary navy. Their armed vessels received a terrific hammering from the 13.5- and 15-inch guns of the British, and it was their very excellent armor protection, and particularly the protection afforded to the vitals by well-disposed deck armor, which kept the high-explosive shells out of the magazines and enabled the badly punished fleet to get back to port.

Not only will the "Ostfriesland" give us an excellent opportunity to determine just how much and what kind of damage the various types of shell can do on a comparatively modern battleship, but she can be used for practice at those extreme ranges of 18,000 to 20,000 yards and over at which future engagements will probably be fought.

As to the fast cruiser "Frankfurt" and the three destroyers, it is certain that even if the terms under which we received these ships did not call for their destruction within a year, they are in such poor condition as the result of neglect and submersion at Scapa Flow that it would never pay to repair them for use in our own Navy. Even if they could be refitted and placed in commission, they are so different in speed, accommodation, character of armament and general maneuverability that it would be difficult, if not impossible, to fit them conveniently into our fleets.

## Naval and Military

**National Guardsmen to Enter West Point.**—The attention of the Governors of the several states has been called by the War Department to the fact that enlisted men of the National Guard who on July 1st, 1921, shall be from nineteen to twenty-two years of age and shall have served one year in the National Guard will be eligible for selection as applicants for admission to the National Military Academy.

**The Fastest American Destroyers.**—All American records for speed were broken by the torpedo boat destroyer "Satterlee" during her standardization firing over the measured mile off Rockland, Maine, when she made a mile at the rate of 38.26 knots. The best previous record of 37.04 knots was held by the American destroyers "Dent" and Wickes." The boat also established a new record in her class for horsepower, developing a maximum of 31,223. The "Satterlee," which has been in commission six months, was built by the Newport News Shipbuilding and Dry Dock Company.

**The Fifteen-Inch Guns on the "Hood."**—At first sight it may seem strange that the "Hood" should carry only the same armament as the "Queen Elizabeth," built some eight years before the "Hood." As a matter of fact, the "Queen Elizabeth's" guns are forty-two calibers in length; but the guns of the "Hood" are forty-five calibers long and have greatly increased muzzle velocity. It is believed that the gun weighs a little under one hundred tons and fires a 1,950-pound shell with a muzzle velocity of 2,800 foot-seconds. Another improvement over the "Queen Elizabeth" is that the new guns have an elevation of thirty degrees for a maximum range of 38,000 yards. The loading gear has been so improved that the "Hood" is credited with being able to fire a salvo of eight guns every thirty-five seconds.

**The Aircraft-Carrier "Eagle."**—When the British decided to build a fleet of aircraft carriers they changed the design of one of the battleships so as to provide landing and starting platforms and interior accommodations for aircraft. This ship has recently been completed, and she forms the third large aircraft carrier, the others being the well known "Argus" and "Furious." Many British officers consider that the "Eagle" is altogether too slow to make an efficient aircraft carrier. She was originally constructed as a dreadnought battleship for Chili. Her designed speed was 22.75 knots, and it is possible that her lightening up due to the removal of heavy guns, ammunition, et cetera, may have enabled the speed to be raised to 25 knots. An aircraft carrier, however, should have at least 30 knots speed.

**Japanese Strength in Super-Dreadnoughts.**—We are not among those who believe that the growth of the Japanese fleet represents any threat to our naval supremacy in the Pacific. When the super-dreadnoughts that Japan has built or now has on the ways, or has proposed for construction, have been completed, she will have in dreadnoughts of the first class only a little over one-half the super-dreadnought strength of the American fleet when the three-year program of 1916 has been built. At present she has four of this class and has under construction four others, so that when all are completed she will have a total super-dreadnought tonnage of 251,000. Even if our super-dreadnought fleet is equally divided between the Atlantic and the Pacific, we would still have a great excess in strength in the Pacific over this Japanese fleet.

**Warship Tonnage of the World.**—In a statement made by Rear Admiral Albert P. Niblack, Director of Naval Intelligence, before a Committee of Naval Affairs, the warship tonnage of the principal naval powers on July 1st, 1919, was as follows: The vessels completed in total tons were, for Great Britain, 2,652,130; the United States, 1,160,355 tons; France, 623,850 tons; Japan, 580,716 tons, and Italy, 454,293 tons. The total tonnage of ships building was for Great Britain, 246,650 tons; for the United States, 995,313 tons; for France, 247,050 tons; for Japan, 267,250 tons, and for Italy, 147,250 tons. These figures for ships built must be reduced for Great Britain by several hundred thousand tons, for the 150 vessels, including pre-dreadnoughts which have been stricken from the list. Similar deductions on a smaller scale should be made for the other powers.

## Astronomy

**More Newspaper Astronomy.**—An English newspaper, quoted in *Popular Astronomy*, undertakes to answer the question "Why Is the Moon Not Always Round?" and enlightens its readers in the following terms: "It is. The reason it changes in appearance is that the earth's shadow is thrown upon it by the sun, and the size of the shadow varies each night when the moon is visible."

**Sunspots Visible to the Naked Eye.**—The frequency of sunspots large enough to be visible to the naked eye is greater than is generally supposed. At a recent meeting of the British Astronomical Association it was stated that members of the Solar Section of the society had observed the sun with the naked eye on 302 days during 1919, and on 126 of these days spots had been seen with the naked eye.

**Spectroscopic Parallaxes.**—Messrs. Adams, Joy and Strömberg report that the rapid accumulation of parallaxes determined with a high degree of accuracy by the trigonometric method has made it possible to complete a revision of the standards of reduction used in the new spectroscopic methods of determining parallaxes, and to derive values that may be considered as subject to but little modification in the future. In their comparison of the results of the two methods they have used trignometric parallaxes for 657 stars. Omitting a few stars that present special difficulties in the application of the spectroscopic method, the average difference between values found by the two processes is only .001 second of arc—a difference comparing favorably with that found between the results obtained by different observers using the trigonometric method alone.

**Occultation of a Star by Saturn.**—The occultation of the star Leipzig I., 4091, by Saturn on March 14, 1920, was observed under favorable conditions at Mr. Reid's observatory, Rondebosch, near Cape Town. From the report of the observations published by Mr. Reid, it appears that certain phenomena were of striking interest; viz. (1) there was very little diminution of light when the star was behind the ring, and (2) the light of the star died out gradually before immersion, and on its reappearance the star seemed to be within the disk of Saturn. From the first of these facts, says the *Journal* of the British Astronomical Association, seeing that the ring is now turned to us almost edgeways, it would seem that the particles of which the ring is composed are either very much smaller or farther apart than they have heretofore been supposed to be. From the second observation the inference may be drawn that Saturn is a smaller globe than has been assumed, and that it is surrounded by an atmosphere of considerable extent.

**Color Changes on Jupiter.**—Writing in the *Monthly Notices* R.A.S., Mr. A. Stanley Williams deals at length with a recurrent change in the color of Jupiter's equatorial zone. This zone is normally nearly pure white. Toward the end of 1869, Mr. John Browning called attention to a remarkable change to a deep tawny yellow, and several attempts were made about that time to trace the history and possible periodicity of similar changes previously observed. With the observations since accumulated at his disposal, Mr. Williams finds that during the past 150 years there have been at least five occasions when the tawny color made its appearance in a very definite manner, viz., 1789, 1839, 1860, 1871 and 1898. Its visibility generally lasts about three years. It has recently reappeared, and was described last April as very conspicuous. Apart from this broad orange-colored band the planet is, at present, remarkably free from color. Taking into account certain less definite appearances, Mr. Williams finds a period of 11.95 years. This is so near the planet's period of revolution around the sun that the true period is probably identical with it. The tawny color makes its appearance a little before the planet reaches perihelion. The writer has found nearly the same period for changes in the color of the two dark equatorial belts. A connection with the sunspot period naturally suggests itself. This is generally supposed to be about 11.1 years, but it is noteworthy that Professor Turner, by harmonic analysis, has derived a period of 12.0 years for the interval 1860-1894 and also for the interval 1889-1919.

## Aeronautics

**Holland to Java Flight.**—The Dutch Government contemplates offering a prize for the first Dutch aviator who flies from Holland to Java. Three competitors have already offered themselves. Lieutenants Backer and Wullften Palthe, who will make the journey in a Vickers F-3, fitted with two Rolls-Royce engines, will fly from Amsterdam via Brest, Marseilles, the Piraeus, Basra, Karachi to Culcatta, and thence via Rangoon, Penang and Singapore to Batavia, in Java.

**Gordon-Bennett Cup Race.**—The French Aero Club will make the contest for the Gordon-Bennett Aviation Cup an occasion of considerable importance, according to all reports from France. The race is to be the principal event of an "Aviation Week," in which aviators from numerous countries will compete for prizes. Rumor has it that the United States has several surprises in store for the Gordon-Bennett race, among these a new engine of tremendous power for its weight. It would not surprise us if the American aircraft manufacturers were well represented; indeed, an American may even win the great contest if all we have heard about the new engine is true.

**Oxygen Heater for High Fliers.**—The Army is conducting tests on a new apparatus for heating oxygen at high altitudes, in order to prevent a recurrence of failure such as experienced by Major Rudolph Schroeder recently in his record climb. The apparatus consists of a refined thermostatic interrupter in connection with electric resistance coils, attached to the oxygen generator. The apparatus heats the oxygen as it leaves the exhaust valve of the container, and keeps it heated until it reaches the distributer. This prevents any moisture present from freezing in the delicate distributer, and it also heats the oxygen again before it enters the pilot's mask.

**Our Dirigible R-38.**—We understand that the American crew to be trained in England to fly back our monster airship, the R-38, has been selected. We hear also from England that the ship will be ready to commence her exhaustive trials fairly soon. It takes a long while to tune up an airship—there are so many balances to be perfected, apart altogether from engine trials and the like. The following figures which have not been published in this country before will give a fair idea of the dimensions of the R-38, in comparison with the R-34, which flew the double Atlantic journey last summer.

| | R-34 | R-38 |
|---|---|---|
| Length (in feet) | 639-5 | 695 |
| Capacity (in cubic feet) | 2,000,000 | 2,700,000 |
| Tonnage | 60-7 | 92-0 |
| Maximum Speed | 58 | 70 |

The German airship "Bodensee," to which so much publicity has been given, is more than one hundred feet shorter than the R-38, has a gas capacity of only 700,000, and is of 21-3 tonnage. It is claimed, however that her maximum speed is 80. Her main disadvantage is obviously her inability to travel great distances on account of her limited gasbag capacity.

**High Speed and High Altitude.**—Major Schroeder after his recent height record flight, made an interesting statement that he believed that at great heights—heights beyond those he has reached—it would be possible to make use of air currents and to fly at enormous speeds. Some French inventors now claim that in a few years it will be possible to fly at a height of 40,000 feet and maintain a speed of nearly 300 miles an hour. Mr. Kipling many years ago prophesied that in an aircraft all metal and of cigar shape we should hurtle through space at heights of rarefied atmosphere where there was practically no air resistance. What exactly the propellers would have to bite upon he did not disclose. But the French inventors have produced a mechanism which compresses the air in which the propeller rotates to normal atmosphere. The economic value of this invention is obvious, for the higher one goes the more quickly one travels and the quicker the journey is accomplished the less fuel will be used. On the other hand, if there be these furious air currents at very great heights as Major Schroeder hints, there will be insurmountable air resistance in some directions. By the way, someone recently referred to the gallant Major as the man who had fallen farther than anyone except Adam!

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***Left:*** **In the coal mine, with the miner and laborer. The ever-increasing wages of the coal hands is reflected in large degree in the high price of coal.** ***Right:*** **The coal breaker, where the coal is broken and the slate removed, making the coal ready for market**

# Is There a Coal Shortage?

## A Survey of the Coal Question in Our Largest Coal-Consuming Center

By Harry A. Mount

*WE cannot get along without coal. Even in this enlightened age of hydro-electric developments, oil-fired boilers, gasoline engines, alcohol-burning devices and so on, coal remains the prime fuel of business and home alike. The recent rumors of an impending coal famine this coming winter have naturally caused great consternation far and wide. A coal famine would affect our industries, public utilities, railroads, steamship lines, homes, personal health—in a word, our entire national life. Truly, this is a grave question of the moment. We assigned the task of investigating the coal situation to Mr. Mount, and in the accompanying article he reports his findings. It appears as though there will be no coal famine, barring unforeseen events.*—THE EDITOR.

TAKE your watch from your pocket between five and six o'clock in the evening and count off sixty seconds. During that brief time seventeen tons of coal—nearly enough to fill one of the largest coal cars—has been shoveled under the boilers that furnish power to run New York City's network of subway, elevated and surface car lines, furnish electric power for lights, and supply gas for cooking. More coal is burned at that hour than at any other; but in a single day 15,000 tons are required for these three public utilities—transportation, electric current, and gas.

If all this coal were loaded on a single train it would stretch out more than five miles. This coal must arrive day in and day out, month after month with unfailing regularity. Much depends on it. If these utilities were left for a day without coal the great city would be utterly paralyzed and the effects would be felt in every corner of the land.

If the gas supply fails in a smaller community, one can rig up an oil or coal stove, or even find wood enough to cook the family meals; but imagine the result if each of the hundred or more families in a big apartment house each suddenly had to find coal or wood and proper stoves to burn it. Utter confusion would result if the whole city were suddenly cut off from its gas supply. And New York is not supplied with natural gas but with artificial gas, made from coal.

If a city the size of Cleveland or St. Louis finds its street car service suddenly shut off, the citizens usually can press busses or automobiles into service, or walk, and the city's business goes on. But even if enough busses could be found to carry New York's great throngs of workers, there would not be enough room on the streets for them. Transportation lines overhead and underground are absolutely necessary, for the streets are overcrowded with normal traffic.

If electric power is a great convenience in smaller cities, it is an absolute necessity in New York. Without it elevators would stop, many of the smaller industries would halt for lack of power, practically every light in the metropolis would be extinguished and almost countless other activities would cease. The tallest buildings would be without fire protection because steam fire engines cannot throw a stream of water to their tops and powerful electric motors are depended upon.

In short, should the coal supply of New York's public utilities cease the city would be completely paralyzed. Should the tie-up last for any considerable period the city's great freight terminals would become glutted with freight, which could not be loaded on boats. Since New York is the "neck of the bottle" for most of the country's export trade as well as a considerable part of the raw material which keeps our own factories in New England and coast points running, the effects of such a tie-up would soon be felt outside the city. Railroads which keep a steady stream of freight moving into New York would have to cease shipments and the freight congestion would soon extend far inland. Drastic measures would have to be taken to keep New England factories running and the extra freight cars needed in this effort would draw from the already meager supply and slow-up freight movement throughout the entire country. A long shut-down of New York's public utilities would start a cycle of calamitous events from which every man, woman and child in the country would suffer.

And then consider the strength of the thread upon which this continued service hangs. Because of the enormous quantities of coal used, and the lack of storage space on crowded Manhattan Island, no great reserve supply of coal can be kept on hand. Some of these utilities have no more than two weeks' supply even in normal times. Many of them have less at present. A steady stream of coal must pour into their bins from the mines or disaster is imminent.

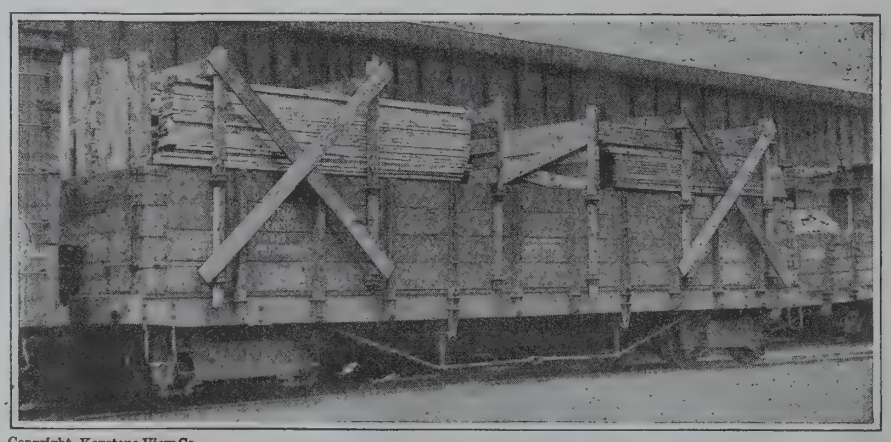
We have heard much recently of an impending coal shortage. But so far as the public utilities of New York are concerned, there is no coal shortage at present. Executives of the largest companies agree that they can buy all the coal they need. Because their supply of coal must come in a steady stream, rain or shine, good times or bad, they are regarded as "A1" customers by the larger coal mines. As a rule the public utility companies buy independently at the mines. In some cases it is necessary to contract for more coal than is actually used, but on the whole an adequate supply is available.

Investigation shows that in the case of one or two small public service corporations which have complained bitterly of a "coal shortage," the real trouble is that they are unwilling to pay the present market price for coal and are living a "hand to mouth" existence in the hope that coal prices will drop.

It is true, however, that almost all of the large companies have not on hand a normal coal reserve. This is the result of cumulative causes rather than any sudden emergency. During the coal strike of last winter the reserves were depleted. The strike delayed shipments to the Northwest until the Great Lakes were frozen over and then shipments which would have been made by boat had to be made by rail. As a result many coal cars instead of making a four-day trip to Cleveland or Toledo, made four-week trips to Duluth. This drew heavily on the already inadequate supply of coal cars, adding to the uncertainty of deliveries to New York.

Then followed the influenza epidemic which had the effect of making deliveries still lower and more erratic. And finally, when traffic was getting back to normal, there came the "outlaw" rail strikes and the transportation system of the East was again tied in knots, many of which have still to be untied.

(*Continued on page 189*)



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**Much has been said about the use of coal cars for transporting building materials. Here is undeniable evidence that such has been the case. This practice is in direct violation of the Interstate Commerce Commission's ruling**

## A Concrete Oil Tanker

THE launching of the 7,500-ton concrete oil tanker "Cuyamaca" recently took place at San Diego, Cal. The ship, which is shown in the accompanying illustration, is 434 feet long and as trim as any steel freighter. Just behind the "Cuyamaca" is a sister ship soon to be launched. The two tankers were built for the United States Shipping Board and have been chartered by the France and Canada Steamship Company. These two ships formed part of the Shipping Board's program for the construction of a fleet of concrete freighters. It has been announced that it is not the intention of the Board, at least for the present, to build any more of this type.

**Launching of the concrete 7,500-ton, 434-foot, oil tanker "Cuyamaca" at San Diego, Calif. This and a sister ship, shown astern in the picture, were built for the U. S.Shipping Board**

## The Contest for the Harmsworth Motor Boat Trophy

IN preparing for the 1920 contest for the famous Harmsworth trophy for motor boats—one of the most coveted of international trophies, American builders, profiting by past experience, constructed three boats of exceptionally high power in proportion to their size and weight, which were designed to meet the variable conditions at the course, which is laid off the Isle of Wight. We present illustrations of these three boats—"Miss America," "Miss Detroit V" and "Whip-po-Will, Junior."

It is needless to say that all three are of the hydroplane type, and each of them developed on trial speeds which made the prospects of our capturing the cup look very favorable. "Whip-po-Will," owned by Albert L. Judson, of New York, was the most powerful of the three American crafts, being driven by two Bugatti engines in tandem, whose combined horse-power is about 900. Unfortunately, during the preliminary tuning up of this boat on the day before the races, she caught fire and sank. The other two boats were designed and built by G. A. Wood, of Detroit, who more than any other man in this country has contributed to the development of hydroplanes of extremely high speed. Both boats have the same motive power, consisting of two reconstructed Liberty engines, driving separate propellers, the combined horse-power being about 800. The faster boat of the two, "Miss America," is a craft of extremely small dimensions, considering her great horsepower. She is twenty-six feet in length by seven feet in beam. Experience on the other side has shown that a boat of such dimensions and speed is at a serious disadvantage in the choppy seas which are liable to be experienced on the Isle of Wight course, and accordingly Mr. Wood built another boat of the same horsepower and driven by the same type of engine as "Miss America," but considerably larger and more seaworthy. This boat which he named "Miss Detroit V" is 38 feet long and 8 feet in beam. It was known that some of the foreign competitors would probably build up to the limit of length at forty feet, and Mr. Wood figured that, with his two boats in the race, he would be prepared to meet whatever weather conditions might be found on the day of the race.

**"Miss America," built and owned by G. A. Wood of Detroit, Mich. Winner of the Harmsworth Cup. This little craft, 26 feet length by 7 feet beam, is driven by two 400-H.P. Liberty motors**

The course of thirty miles was covered in five rounds of six miles each. As competitors the two American boats had "Maple Leaf V" and "Maple Leaf VI," owned by Sir Mackay Edgar, and "Sunbeam Desenjol," which belonged to Mr. Coat Allen. In the first race "Miss America" came in first, having covered the thirty miles at an average speed of 51.45 knots, her fastest lap being covered at the rate of 56.63 knots. "Miss America" covered the course in 38 minutes 17 2/5 seconds; "Maple Leaf VI," second, in 41 minutes 30 seconds; the third boat, "Sunbeam Desenjol," took 43 minutes 30 seconds; and "Miss Detroit V," the fourth in line, required 46 minutes 12 3/4 seconds for the thirty miles. The comparatively slow time of "Miss Detroit V" is due to the fact that she developed engine trouble in the fourth round, and after that she was unable again to maintain her maximum speed. "Maple Leaf V" also had engine trouble and had to retire from the race, which put "Miss Detroit" in the fourth place.

The second day's race was also won by "Miss America," with "Miss Detroit V" in second place, "Maple Leaf V" third, and "Maple Leaf VI" fourth. The time of "Miss America" for the thirty miles was 37 minutes 5 1/3 seconds, and her average speed was 53.42 knots. Her highest speed, made during the first lap, was 56.41. "Miss Detroit V" took 37 minutes 43 4/5 seconds to cover the course, and "Maple Leaf V" took 37 minutes 59 seconds. "Maple Leaf VI" was fourth and "Sunbeam Desenjol" fifth.

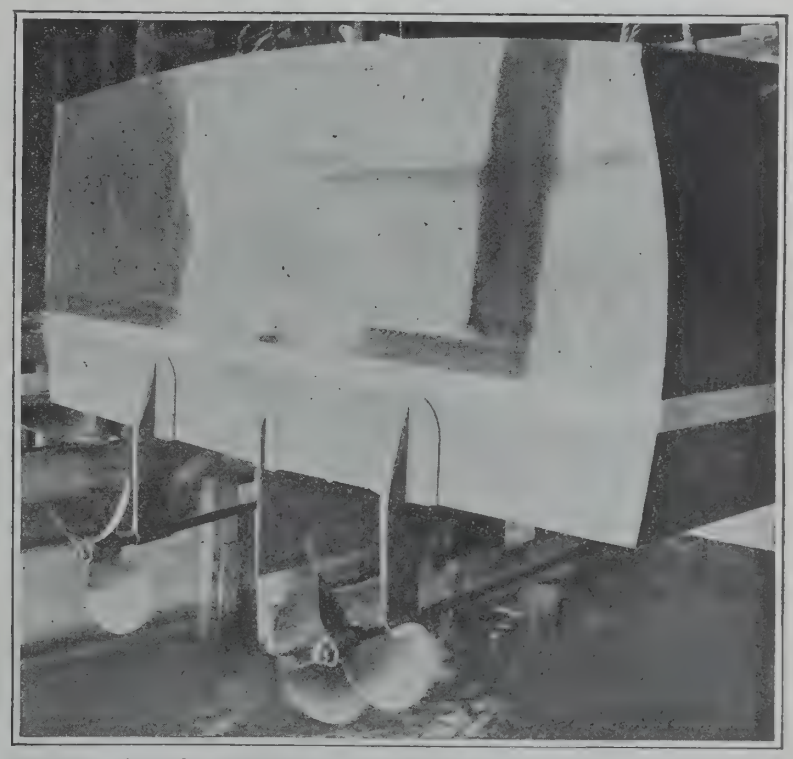
The Harmsworth Cup comes once more to America, and as Sir Mackay Edgar, owner of "Maple Leaf V" expresses his purpose to build a faster boat and try again, we may see another race for the Cup next year, probably on the Detroit River.

## Oil, Sugar and Alcohol from an African Tree

THE sump tree or *Balanites aegyptiae* Del., five or six million tons of whose fruit are gathered annually in Senegal, is a variable source of oil, sugar, and alcohol. The fruit consists of an oleaginous spindle-shaped kernel enclosed in a hard fibrous shell and surrounded by sweet pulp containing a very high percentage of sugar and enclosed in a tough skin. The kernel contains 41.80 per cent of fats and 25.32 per cent of nitrogenous substances. However, the shell is so difficult to crack that only the pulp can be at present considered useful for industrial exploitation. This pulp contains sufficient fermentable material to hold from 9.7 to 10.8 cm. of sugar per 100 gr. of fruit. The composition of the fruit is as follows: sweet pulp, 42.9 per cent; shell, 48.3 per cent; oil bearing kernel, 8.8 per cent. The sweet pulp contains 40.3 per cent sugar.

**"Miss Detroit V," built by G. A. Wood. Length 38 feet; beam 8 feet. Driven by two 12-cylinder, 400-H.P. Liberty motors**

**"Whip-po-Will Jr.", owned by A. L. Judson, N. Y., is driven by two 16-cylinder, American-built Bugatti motors, in tandem. Horse-power 900**



**The stern view of "Miss Detroit V," showing method of supporting the twin, 3-bladed propellers, on each of which 400 horse-power is developed**

# An Engineering Bulwark

## The Proposed Standing Army, for Purposes of Peace, of the Men Who Know How to Do Things

By Richard L. Humphrey

THE average citizen in this country has little knowledge of the work of the engineer. To him the word "engineer" means the man who runs a locomotive or some other steam engine, or in some cases he recalls that his plumber has under his name "Sanitary Engineer." He does not associate with the engineer the great transportation systems of the country, the street railway service, the telephone and telegraph, the office buildings, the water supply, the sanitary disposal of sewage, the lighting systems, the street pavements and highways, proper housing and town planning, to say nothing of the bridges and other structures that safely carry millions of people, all of which are daily necessities. Nor does he realize or appreciate the fact that the marvelous development of this country and of its resources has been an engineering achievement in which the engineer has been a pioneer.

During the war the engineer came into a prominence hitherto unknown by reason of the fact that he was essential to the winning of the war and it early became apparent that the engineer was doing yoeman service. It is no disparagement of the bravery of the flower of the American people who fought in France and Flanders to say that their work would have been of little value had they not been supplied at the critical moment with the vital munitions of war. The brilliant work of the engineer in providing Europe with harbor, transportation, housing, commissary and telephone facilities is a matter of common knowledge; and this is also true (though to a lesser extent because more removed from the theater of war) of the tremendous work done in producing ammunition, guns, airplanes, locomotives and cars for the transportation of these munitions of war in this country as well as in Europe; and particularly is this true of the ships which were so vital a factor in the feeding of the American Expeditionary Forces. The spectacular building of ships has been one of the wonders of the world. During this time it became evident to the public that the engineer was a prime factor in this achievement.

The war, therefore, created in the mind of the public a greater appreciation of the services of the engineer and created in the engineer a greater desire for service. The needs of the Government for engineering assistance during this crisis led to the creation by the four great National Societies, the American Society of Civil Engineers, the American Institute of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, of an Engineering Council to provide a medium "for the consideration of matters of common concern to engineers as well as to those of public welfare, in which the profession is interested, in order that united action may be made possible." In February, 1919, and in April, 1920, the American Society for Testing Materials and the American Railway Engineering Association became respectively the fifth and sixth members of this Council.

Among some of the things that this organization has accomplished may be mentioned:

1. Furnished to Government departments four thousand names of engineers for technical duties; aided the Naval Consulting Board and the Army General Staff in examining 135,000 suggestions and inventions for war devices, and coöperated with the Fuel Administrator and the Bureau of Mines in conserving coal;

2. Helped secure exemption of engineering students from military service until the completion of their technical training;

3. Organized the Engineering Societies Employment Bureau in November, 1918, which since the armistice has registered 5,500 engineers and assistants, mostly returned soldiers and naval men, and has aided thousands to positions without charge;

4. Through a direct appeal to President Wilson, Council brought about a conference of fourteen different Government offices, engaged in map making, with the prospect of greatly accelerating the completion of the topographical map of the United States. It is now hoped to have the whole country mapped in a decade and a half; at the former rate, the Twentieth century would have ended before the map was finished.

5. Established an office in Washington January 1, 1919, under the general direction of the National Service Committee. Through this office engineers have been put in contact with the Federal Government as never before, individuals, companies, and societies have been furnished information about the activities of Congress and the departments of the Government, and useful services have been rendered to the Government;

6. Joined with National Research Council in a report on and improvement of the Patent System and Practice, on which legislation has been passed;

7. Participated in organizing the National Board for Jurisdictional Awards in the Building Industry and has a member thereon;

8. Sent delegates to Washington on the invitation of a Committee of the House of Representatives to present testimony before the committee in favor of a national budget;

9. Has recently organized a Committee on Types of Government Contracts;

10. Is studying the curriculæ of engineering schools, and making suggestions as opportunity offers;

11. Assisted the State of New York in preparing a scheme for organization of State Government.

As a result of the war experience, the American Society of Civil Engineers, in June, 1918, authorized the appointment of a Committee on Development by a resolution, the preamble of which was in part, as follows:

"Sociological and economic conditions are in a state of flux and are leading to new alinements of the elements of society.

"New conditions are affecting deeply the profession of engineering and its service to society in its various relationships to communities and nations, and in its internal organizations.

"A broad survey of the functions and purposes of the American Society of Civil Engineers is needed in order that an intelligent and effective readjustment may be accomplished so that the society may take its proper place in the larger sphere of usefulness now opening to the profession. . . .

"Any changes in organization must take into account all the conditions above indicated, and also the relationship of the American Society of Civil Engineers to other engineering organizations and to the public."

Similar committees were subsequently appointed by the American Society of Mechanical Engineers and the American Institute of Electrical Engineers, and the American Institute of Mining and Metallurgical Engineers. The problem of these committees concerned both internal relations and external relations and in dealing with the latter, conferees were appointed from the four societies, which met in August of 1919 and organized the Joint Conference Committee. Its report in September of that year recommended "the formation of a single comprehensive organization to secure united action of the engineering and allied technical professions in matters of common interest to them" and at the joint meeting on January 23, 1920, of the members of the governing boards of the four societies, of the American Society for Testing Materials, of the members of the Engineering Council and the Trustees of the United Engineering Society, unanimously requested the Joint Conference Committee to call without delay an Organizing Conference of representatives of the national, local, state and regional engineering organizations of the country for the purpose of bringing into existence the comprehensive organization recommended by this committee.

In compliance with this request the Joint Conference Committee issued a call, in response to which there convened in Washington one of the greatest conferences of engineers in the history of this country. There were present one hundred and forty delegates representing seventy-one engineering and allied technical organizations having an aggregate membership of upwards of one hundred and twenty-five thousand. The spirit of the conference and the unanimity of purpose expressed in the formation of The Federated American Engineering Societies and the adoption of its constitution and by-laws without a dissenting vote, clearly indicates that the engineer had been aroused as never before to a sense of his responsibility as a citizen; and there was a constant expression of his desire for unselfish service in the common weal.

At that historic Washington Conference was laid the foundation for the greatest engineering organization in the world. When formal invitations to become members of The Federated American Engineering Societies had been a week in the mail, the aggregate membership of the societies that had already accepted make it the greatest engineering organization in this country and before the American Engineering Council meets it will be the greatest engineering organization in the world.

The prime underlying purpose of the organization is unselfish service to the public. That it is not organized for selfish purposes is indicated in the preamble to the constitution which is as follows:

"Engineering is the science of controlling forces and of utilizing the materials of nature for the benefit of man, and the art of organizing and directing human activities in connection therewith.

"As service to others is the expression of the highest motive to which men respond and as duty to contribute to the public welfare demands the best efforts that man can put forth, now, therefore, the engineering and allied technical societies of the United States of America, through the formation of The Federated American Engineering Societies, realize a long cherished ideal—a comprehensive organization dedicated to the service of the community, state and nation."

The organizing conference in Washington entrusted the Joint Conference Committee with making provision for putting the conclusions of the conference into effect and authorized it to act as an ad interim committee between the adjournment of the conference and the first meeting of the American Engineering Council.

Engineering Council at its meeting in June heartily endorsed The Federated American Engineering Societies and the American Engineering Council and authorized:

"Its Executive Committee to proffer and perform on the part of Council such assistance as may be practicable in completing the work of the Organizing Conference and of the Joint Conference Committee of the Founder Societies in establishing the American Engineering Council."

The activities of Engineering Council will be formally taken over by the American Engineering Council January 1, 1921. One of the important matters started by Engineering Council, which will be carried on by the American Engineering Council, is the movement to create a National Department of Public Works, which has crystalized in a bill now before Congress, known as the Jones-Reavis Bill, for the establishment of a National Department of Public Works by modification of existing departments. This bill, by concentrating the engineering and construction activities of the Government in a single department, will effect an annual saving of a very considerable amount, will eliminate duplication of effort, and so coördinate the work as greatly to increase its efficiency and place the construction of public work on a business basis, by which it may be done more efficiently both as regards its cost and time required for its completion. This movement is entirely in accord with an effort to secure a national budget in which effort Engineering Council has partici-

(*Continued on page 190*)

*CONSTANT repetition weakens as well as strengthens, and it is an old, old story what the engineers did in the great war. Perhaps it is not generally realized, however, that much of this achievement was due wholly to the manner in which the engineering resources of the country were mobilized under a single direction. The question now is in order, to what extent are we to see this temporary organization abandoned and to what extent are we to insist that if a thing is good in the war emergency it is good in the routine of peace? Some of the responsible heads of the engineering profession are trying to answer this question on the side of efficiency, and to preserve as a permanent asset the marvelous organization which enabled the American engineer to function so far beyond the fondest expectations during the war. That in a word is the story of the Federated American Engineering Societies, of which Mr. Humphrey, Chairman of the Joint Conference Committee, tells us here.*—THE EDITOR.

# Reclaiming Salt Surfeited Soils

## How a Western Problem Arising Out of Irrigation Methods Is Being Met

By George A. Dacy

MILLIONS of acres of potentially fertile and productive land—adapted propitiously for the growing of staple crops—are lying idle throughout the wide stretches of the plains and valleys of the arid and semi-arid West because they are "alkali" sick. Peculiarly enough many of these ailing soils are on the invalid list because they are surfeited with chemical salts for which many of the eastern farmers pay high prices in the form of commercial fertilizer. As it is, however, the alkali lands are so rich in their content of chlorides, sulfates and carbonates of sodium, as well as in their less bountiful reserves of calcium, magnesium and associated materials, that they are rendered unfit for cropping service due to the fact that the plants cannot survive under such conditions.

The spread of the alkali sickness is largely accomplished by the use of irrigation water as the moisture supply artificially applied in the regions of restricted rainfall is so rich in these soluble chemical salts that its continued use ultimately results in so amply stocking the fields where the irrigation water is applied with these chemicals that they become temporarily useless for further cropping purposes. As a consequence it is necessary for the irrigation farmers to exercise the greatest care and precaution relative to their water supplies. Once a western irrigated field becomes over-stocked with alkali, the only practical method of eliminating the obnoxious chemicals is by flooding the land with uncontaminated irrigation water which will carry away the objectionable and soluble salts. The usual practice is to dig deep ditches which empty over rough, untillable land and which deposit the drainage waters containing the obnoxious salts far enough away from the productive fields to reduce their potential powers of further contamination.

Farmers who wish to purchase agricultural land in the western States of Arizona, Kansas, Nevada and adjoining territory are always anxious to ascertain the alkali susceptibility or content of these soils. Similarly it is fundamentally important to find out definitely the chemical composition of various tracts of land adapted for future irrigation. It has long been desirable that some simple, economical and practical manner of testing these soils for alkalinity be devised. Uncle Sam has been vitally interested in work of this character and the investigations and resourcefulness of the scientists in his employ have been responsible for the inception of a practical test of utmost accuracy.

The Government experts have harnessed the Wheatstone bridge—familiar to all students who have studied physics—for this work. Each national soil surveyor who is engaged in soil mapping and survey work in the western country where alkali soils prevail, now carries a portable salt bridge of this description as one of the most valuable tools in his scientific outfit. The bridge is an electric resistance box in which three of the resistances are known, while the fourth is the one to be determined. A soil auger is used in obtaining a small core of soil which is then washed in a small container in order to extract the soluble salts. The solution is then transferred to a small resistance cup which is placed on the Wheatstone bridge. The operator holds a telephonic listening device to his ear and simultaneously moves the dial hand on the electric resistance box backward and forward until he strikes the point where only a slight murmur is discernible. He then reads the dial and correctly reduces the reading to parts per million of soil by reference to a standardized resistance table which is used with the salt bridge. This figure gives him the alkali content of the soil tested and indicates its adaptability for irrigation and crop production activities.

Any farmer or landowner can operate the salt bridge. It is simple and does not require the services of a scientific expert for the performance of the soil test. The simplicity of the device greatly extends the field of its practical application. It has already proved to be a prize first aid instrument in the soil survey work which the Government is performing in the arid and semi-arid regions. The farmers, ranchers, real estate agents, land buyers and irrigation promoters are also coming to appreciate the great value of this ingenious device in eliminating the gamble from their operations. Hence they are now only making wider use of this scientific test while they also are paying more attention to the reports which Uncle Sam issues officially as the result of the soil survey and mapping operations which he is supervising in the districts under discussion.

Usually in the alkali sections the runoff water from the hills accumulates in the valleys where the moisture evaporates and the salts remain. The Great Salt Lake is an example of such salt concentration. In many instances irrigated farms at the higher levels disseminate the alkalinity of the soil to places below them in the runoff irrigation water. The obnoxious condition of salt concentration and centralization is also spread by the rise of soluble salts in the ground water. Where the water table rises in this manner, alkalis which are deep-seated in the soil are often brought nearer to the surface with the resultant limitation of plant growth.

Throughout the agricultural and irrigated sections of many of the western States, the accumulations of alkali in the soil and on the surface are so pronounced as to blind temporarily those who look at the glittering, white stretches of soil. The farmers of these regions are in many cases exposed to the danger of alkaline accumulations in the soil handicapping their cropping operations, while in instances where such salt contamination does not occur, dry weather and the restricted supplies of irrigation water may seriously curtail annual production. Even after a farm is freed of its excess of alkali, the owner has to practise persistent and complete precautions to prevent his acreage from again reverting to a barren waste. However, the prodigal productivity and fertility of these reclaimed salt soils usually make it worth the farmer's effort to rid them and henceforward to keep them free of these soil-ruinous salts.

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### "Unless Human Nature Is Changed"

To the Editor of the SCIENTIFIC AMERICAN:

In your June 12th issue you quote from the purported word of Lenine to the effect that human nature must be changed before the economic system under which it operates can be changed and yourself imply agreement with the statement. It is questionable that Lenine ever made such a statement. He seems too well read and practical a man to make an assertion antithetical to the facts of history. But the authorship of the statement is immaterial. It is the statement itself that is under analysis. It is a stock argument of capitalism.

It is generally conceded—and you yourself have so conceded in former editorials—that human nature is unchanged since the beginning of history. The world has had four economic systems in that time—chattel slavery, feudal slavery, competitive slavery (or system) and wage slavery (capitalism). In the first the master owned the slave bodily; in the second he owned the land upon which the slave worked and the slave could not leave the land without permission of the master, and was sold with it when it was sold; in the third the slave through the quarrels of the masters, gained sufficient freedom to permit him to fight (compete) with his fellow slave, individually in their respective lines of work, to supply the demands of the masters; in the fourth—capitalism—the master owns the job and the slave is permitted to change masters *ad libitum*—provided his purse will permit. Each of these economic systems is, relative to the slave, an improvement over its predecessor.

Human nature did not change in the transit from chattel slavery to serfdom, neither did it change when serfdom was cast aside and the competitive system adopted, or yet when capitalism came, almost like a flash, human nature remained the same.

History will repeat: "Human nature" will continue to throw off its obsolete systems and adopt better ones—and this is just what Russia—not Lenine—has done.

Lenine is not seeking to "lead" into a "land of the golden rule" as you assert. He simply recognized the fact that the old order—rather disorder—has served the time of its usefulness, that the world is ready for the new.

Your assertion that the Russian movement was an "overnight" affair is incorrect. It had been growing at least half a century. With equal untruth it could be said that the bursting of a seed pod to liberate the ripened seeds within is an "overnight" development. The fact is the obsolete pod was forced to burst by the seeds grown, ripened and ready for the change and demanding opportunity to manifest new life. So it is in Russia—so it is the world over, but elsewhere the "pod" has not been forced to burst.

Lakeside, Wash. WILL A. ROBISON.

To the Editor of the SCIENTIFIC AMERICAN:

I am glad to find the problem of human nature and the social order discussed in a scientific journal, for it is a problem in social science.

Our prevailing difficulty—that not mere scientists but even philosophers seem unable to get around—is to appreciate, first, that the "established order" is basically a survival of pre-historic anarchy in its anti-social spirit and practice; second, that human nature is not taken into account by this "order," with any view to its betterment or social efficiency; third, that were human nature the ideal thing that is commonly supposed to be a prerequisite to a perfected social order, then such a perfected social order would not be an urgent matter; we would get along comfortably together under the pure anarchy that doubtless prevailed ten thousand years ago.

It is chiefly because human nature is so very human, finite, selfish, generous, foolish, crafty and otherwise an uncertain and disproportionate quantity that a perfected social order that Russia has sought over-night, and that our own Bellamy so wisely envisioned, has been the pressing need of the last hundred years.

There has been a vast hitching up of the cart ahead of the horse, or the trailer ahead of the motor, in this discussion; for the stock objection to the establishment of business of, by and for the people has been the parrot phrase, "you can't change human nature."

In this same issue of June 12th an inventor offers yet another form of rotary motor, the ideal in steam prime movers, without making provision for any change in human nature! And therein is discussed new methods for the finishing of cement surfaces with a view to ideals in plastic artistry, and no provision whatever has been made for the conversion therewith of the human nature of cement workers!!

You can't change human nature, therefore you can, and eventually must, change the social order so that the best in human nature may be developed and rewarded, and the worst in human nature discouraged and eventually dissipated; because under such an "ideal" social order it will pay both in material and moral rewards to be good, honest, industrious, modest.

And that order—let me hasten to say—does not involve the abolition of capitalism, as our radical friends feel "ordained and called to preach"; but its installation, as the beneficent invention for the overcoming of pre-historic anarchy that it is, as a national and international function of, by and for the people—a government that will govern—to the public and the private profit.

Human nature is not so very bad; all it needs is a fair chance. It has never had it. A. GEORGE.

Hollywood, Cal.

### Power from the Past

To the Editor of the SCIENTIFIC AMERICAN:

A general reader turned away from the article by C. H. Claudy, Vol. CXXII, p. 700, by its tiresome repetition of a teaching of M. Thomas Cot about "heat long ago stored for us," etc. Thinking twice would have convinced Mr. Claudy that the energy manifested as the heat of an ordinary fire was located immediately before the fire in the oxygen of the burning reaction. If this energy was put into the oxygen by the sunlight it was done when at the leaf surface, the $CO_2$ containing comparatively little energy, was decomposed into oxygen containing much greater energy and carbon with little if any energy. The energy thus going into the heat of the fire may as well have come from the sunlight at a nearby maple leaf, a movement before, as from the sunlight of the "prehistoric days when the coal beds were being formed."

Chicago, Ill. FRANCIS B. DANIELS.

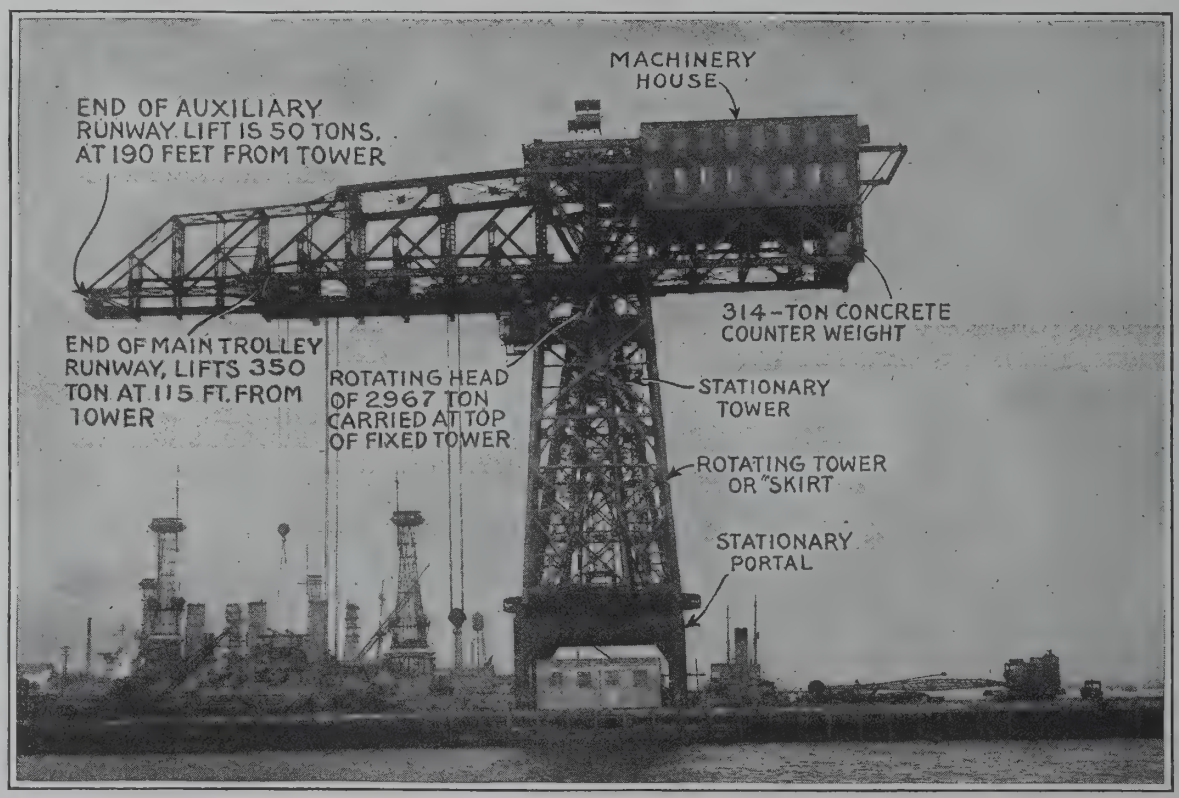
# The World's Largest Crane

## How the Engineer Has Made It Possible to Lift and Swing a 350-Ton Load

THE reasons which prompted the construction of the enormous crane that forms the subject of this article are to be found in the ever-growing size and weight of the elements which enter into the modern dreadnought, and in the desire during the construction and repairs to handle these elements as a whole instead of disassembling them in order to render their lifting and transportation more easy. Thus, for instance, it has been found that in building a battleship time may be saved and the whole work facilitated if the turrets with their handling rooms are erected on the dock and placed aboard the ship in a complete condition. This, of course, means the handling of very heavy weights, particularly in the case of such a ship as the "Pennsylvania" and her class, in which three 14-inch guns are mounted in a single turret. These three guns together will weigh over 300 tons. It is customary, however, to handle the guns independently of the turret, either when the ship is being constructed or when the turret may have to be removed for repairs, but we have already adopted the 16-inch gun, weighing about 125 tons and the weight of armor carried on the turrets for such guns will be heavier than that used in previous ships. So it was decided to build a crane which would be capable of lifting out of a ship a turret with its handling room attached, placing it on shore for overhauling or repairs, and re-transferring it to the ship.

This, the world's largest crane, with a capacity of lifting 350 tons on a reach of 115 feet and 50 tons on a reach of 190 feet, has been built upon a dock which extends from the bulkhead line out toward the Delaware and serves two outfitting basins. Its extreme height is 230 feet, and during its test for acceptance, its load reached a maximum of 980,000 pounds. The total weight of the rotating part of the crane with its maximum load is 5,834,000 pounds, and the total weight of the whole steel structure resting upon its pile foundations is 4,000 tons. The total cost of the crane was $871,000, and of the foundation, $120,000.

However, the mere setting down of these cold figures upon paper, and even the photographic presentment of this great work, fails to give an adequate impression of its stupendous size. It is only when one stands beneath it on the dock and climbs the steps of the central stairway to the platform 200 feet above the dock, that an adequate sense of the immensity of this great framework of steel is realized. There are other extremely large cranes of this character in the world, it is true, one in England and another in Hamburg; but the Hamburg crane, for instance, has a maximum lift of 250 tons as compared with the 350-ton lift of the Philadelphia crane.




**General view of the giant 350-ton hammer-head type crane, 230 feet in height, at the Philadelphia Navy Yard**

The design of the crane was submitted to the Navy Department by the McMyler Interstate Company, and the final design was worked out in coöperation with the engineers of the Bureau of Yards and Docks. It is of what is known as the hammer-head type. The total load of 4,000 tons is carried upon an elaborate pile foundation, which is driven well down into the gravel below the overlying mud, and a lateral support to the foundation is given by a cofferdam fill. Upon this foundation was first erected the massive four-legged plate steel structure which is known as the stationary portal, the four massive legs of which support a system of deep, plate-steel girders which receive and distribute the superincumbent load. Upon the portal has been erected a central octagonal tower, the legs of which are very thoroughly braced together. This tower is finished in a plate-steel head, surmounted by a massive cast-steel cap. At the top of the cap is a turntable, consisting of a nest of horizontal steel rollers, which carries the weight of the rotating part of the structure, amounting to 5,834,000 pounds. The steel rollers are four inches in diameter, and the load works out at 3,800 pounds per inch of diameter by inch of face.

The rotating portion of the crane consists of an outer rectangular frame, known technically as the "skirt," and the overhead girders with their counterweight operating tower, runways, trolleys and hoisting cables. The skirt and the cantilever trusses are built integrally, and move as a single mass.

Now it will be evident from this description that when the crane is under load there will be a heavy overturning movement in the direction of the load, and this will result in a heavy horizontal pull at the top of the tower against the side opposite the load, and a heavy thrust against the bottom of the tower on the side facing the load. At the top of the tower the load is transferred from the moving to the stationary part by means of a nest of vertical steel rollers encircling the head of the fixed tower. These are enclosed in the same case C, as contains the nest of horizontal rollers carrying the vertical load, as above referred to. The horizontal thrust of the base of the skirt against the base of the tower is transferred from the one to the other by means of chains of vertical steel rollers. Each roller is journalled at its upper and lower ends in the links of a chain, the ends of which are secured to the bottom of the skirt or rotating tower. The rollers are carried in chains in order to secure an even distribution of load, and we are informed that the arrangement is giving the greatest satisfaction.

For lifting the heaviest weights, use is made of an equalizer bar, which carries a huge double hook at its center, and is provided with a pair of rings at each end which are engaged by the hooks on the right and left hand hoisting blocks and cables. Each of the two hooks has a lifting capacity of 175 tons, and the hook at the center of the equalizing bar has a capacity of 350 tons. The main hoisting cable leads up to two overhead trolleys, right and left. These trolleys are each carried on eight wheels and they travel over two runways extending from the tower out to the end of the main trusses, giving a reach of 115 feet. There is a third supplementary runway, which is carried by a supplementary and lighter truss extending beyond the main truss. This trolley has a capacity of 50 tons, with a reach of 190 feet.

The outboard section of the cantilever trusses carries at the outer end of its floor a concrete counterweight of 314 tons. The upper part of this section of the truss is occupied by a large two-story machinery house, in which are the 85 horse-power motors, gears and winding drums for operating the hoisting and racking cables. This operating house is itself 200 feet in the air, and is equipped with a 35-ton crane for handling the operating machinery.

An extremely interesting development, during the official tests of the crane, appeared when the four powerful hydraulic jacks at the four corners of the portal, placed there for the purpose of lifting the rotating portion of the crane, were tested out. For it developed as the pressure was increased in the pumps that, before the superincumbent mass was lifted, there was a total compression in the corner legs of the tower of 1½ inches due to the elasticity of the steel. The load lifted was just under 3,000 tons.

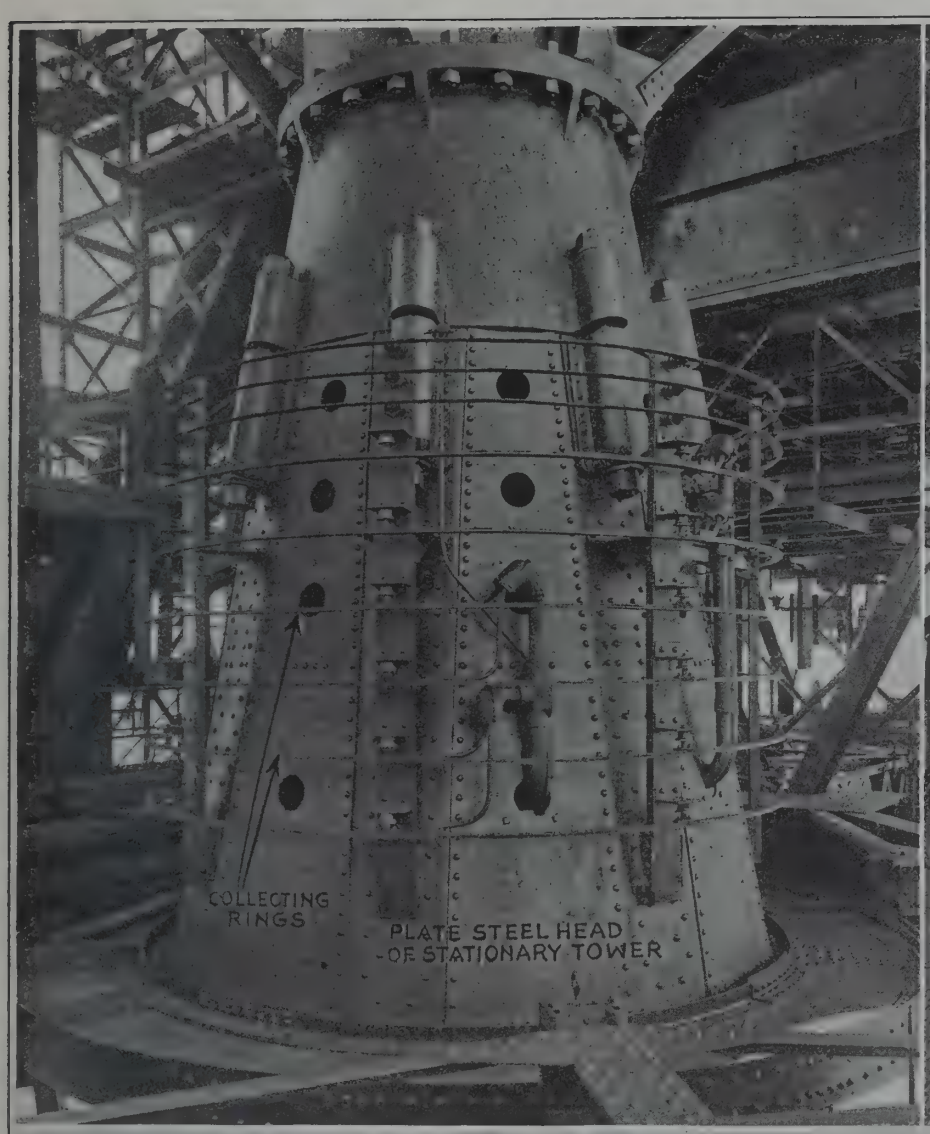
### Sunstroke in Trees

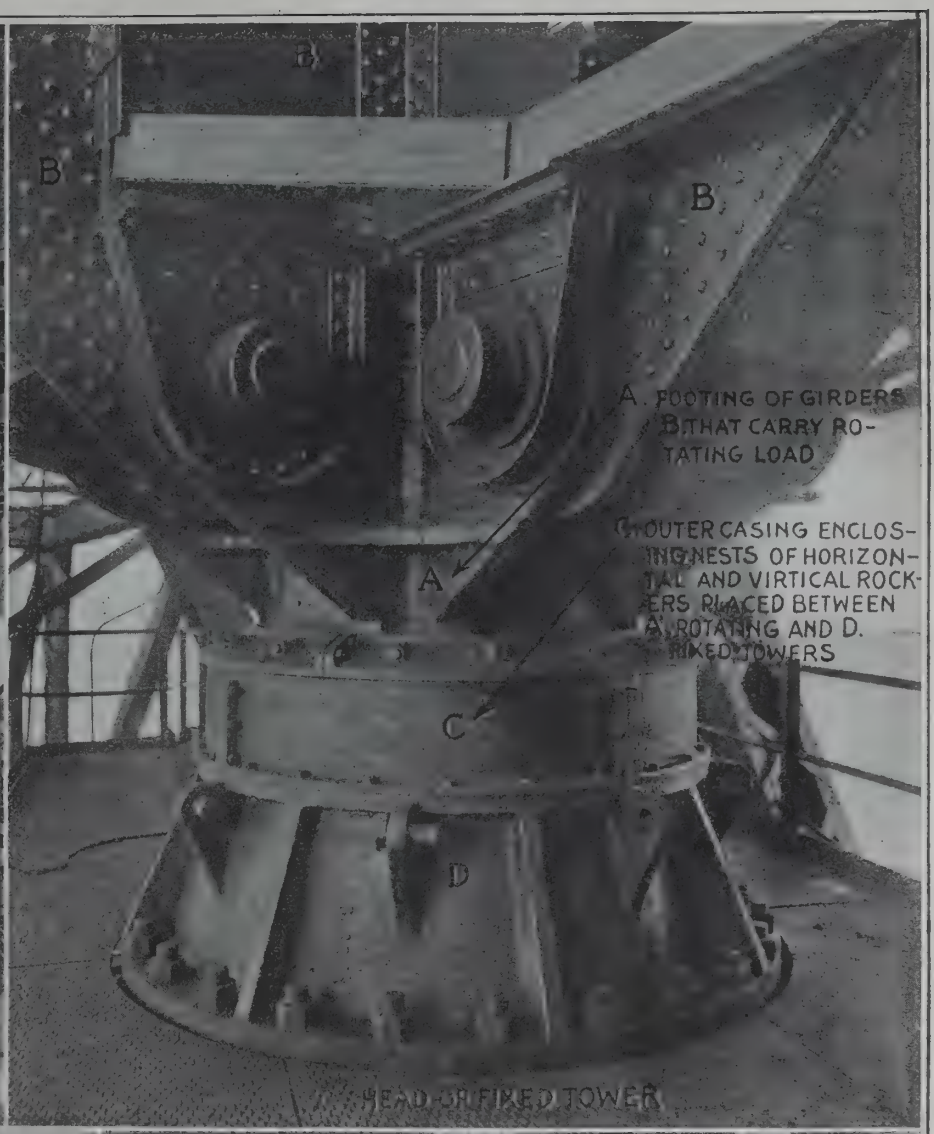
EVERYONE has noticed that a very hot summer frequently causes the early withering and falling of the leaves of trees, especially of those planted in streets of cities. A much greater injury is frequently done, however, by the superheating of the bark, which is far less obvious to the casual eye. It is not too far-fetched, perhaps, to consider such an injury as a sort of "sunstroke" like that which men and animals suffer from. This sort of scorching, when it occurs, is always upon the lower part of the trunk, partly because the trunk is here thickest and, therefore, most readily heated, and partly because the cooling effect of evening is felt latest upon that part of the trunk. Pine trees and beeches growing on the edges of forests shield their trunks by a protective screen of downward hanging branches. It is often supposed that the branches of these border trees grow in this manner simply because there is more room than in the midst of the woods, but it is really a case of protective growth. Other means of protection employed by the trees against this burning effect or strong sunlight is the formation of thicker bark and a stronger layer of cork cells. These protective measures are not employed, however, by trees growing in damp locations, where uncommonly high temperatures rapidly fall when evening comes.

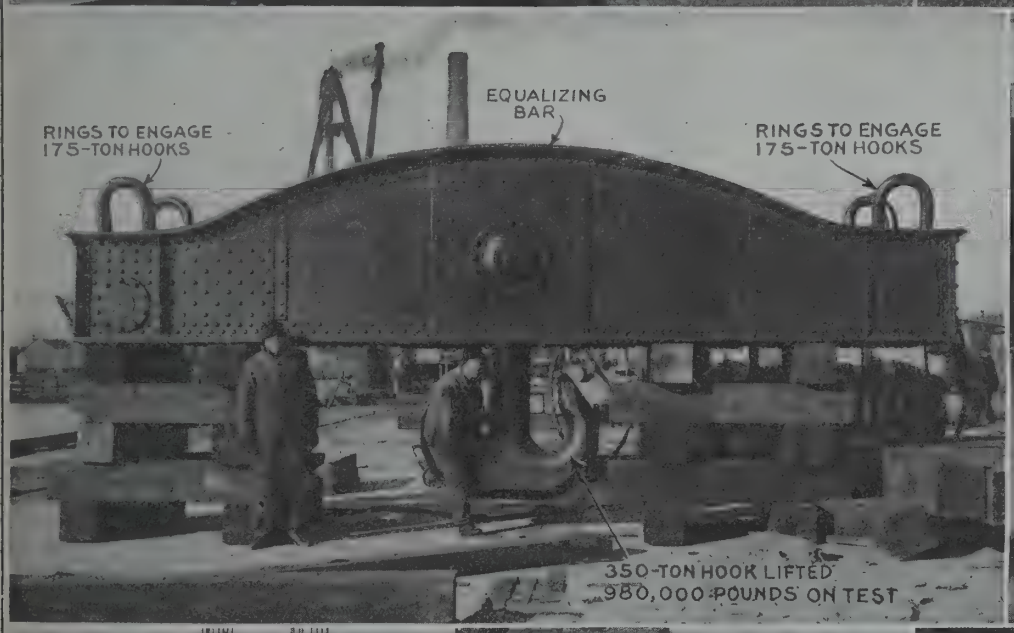
The substance of the wood is actually killed by this superheating of the bark, even if it only occurs in comparatively small spots; it is, nevertheless, a very serious matter, since it causes the bark to split and tear thus forming places where insects and fungi can freely enter the wood and begin their work of destruction.

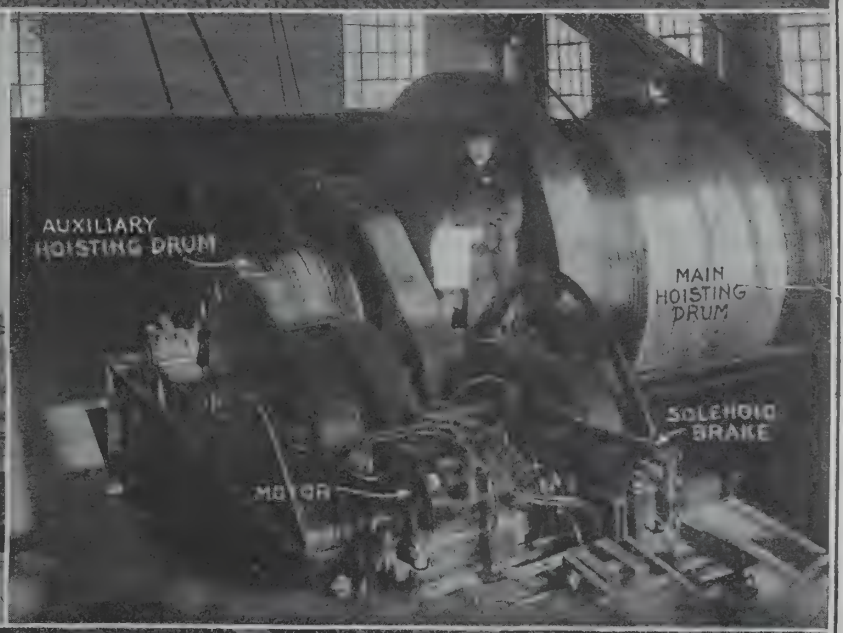
This burning of trees usually occurs not during the noonday hours but in those of the afternoon, and the southwest side of the trunk is the part most often affected. A German investigator, Mr. R. Hartig, who has studied this question, according to an account in *Kosmos* (Stuttgart) found upon examining an eighty-year-old pine tree growing in the open, on an August day when the temperature was 37 deg. Cent. in the atmosphere that the living substance of the wood upon the southwest side of the tree had a temperature of 55 deg. Cent., whereas the south side was fully 10 deg. lower; the northeast side had the lowest temperature, only 36 deg. Cent. This observation involves an important principle in horticulture, namely, that when trees are transplanted they must bear the same relation to the point of the compass as they did in the original location. It is sometimes advisable to shield saplings in the summer by binding straw about their stems until the roots have taken thorough hold in the ground and the crown is well furnished with foliage.

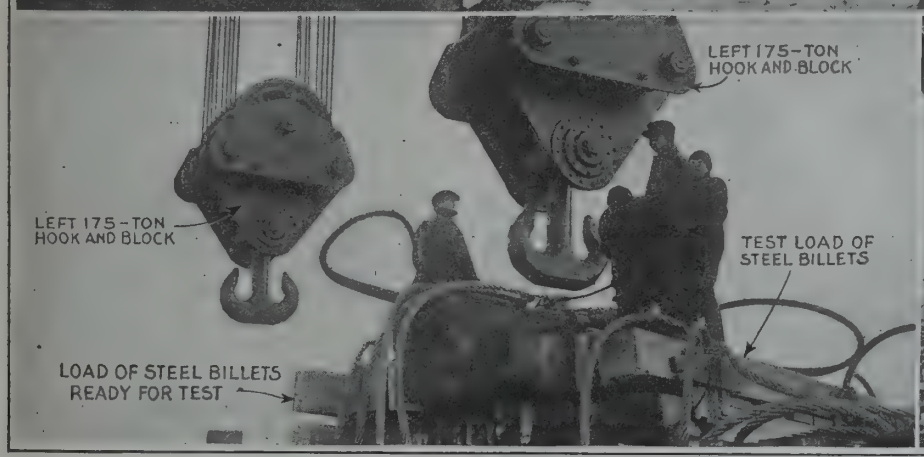
All of which conveys the thought that the transplanting of trees is just as delicate an operation as that of transplanting the usual run of plants, despite the difference in size and the apparent difference in ruggedness. Nurserymen would do well to give this matter careful study and considerable research.



**SOME STRUCTURAL FEATURES OF THE LARGEST CRANE IN THE WORLD, OF 350 TONS CAPACITY, INSTALLED AT THE PHILADELPHIA NAVY YARD**

# Record Weather

## Excessive Precipitation, Temperature Extremes, High Winds, Blizzards, Hurricanes and Tornadoes

By Wendell M. Whiting

DURING the forty odd years that Uncle Sam has kept accurate records of the weather and received information of meteorological phenomena from all over the world there have been gathered some exceedingly interesting, remarkable and startling data.

Along the coasts of this country and also in the interior there have raged some very violent and devastating storms with winds of such great force that in many instances there could be obtained no record of the highest velocity reached because of the fact that the anemometer was blown away or destroyed.

In this hemisphere there are four types of storms that often, but not always, cause very high winds. They are popularly known as cyclones, tornadoes, hurricanes and blizzards. Tornadoes and hurricanes are at all times severe, but cyclones and blizzards need not and do not necessarily bring winds of dangerous force.

The wind velocity during the height of the average western blizzard ranges from 30 to 50 miles an hour. While a gale of that force with a temperature often far below zero is something to be avoided, nevertheless it does not rip and tear and destroy as in the case of hurricanes and tornadoes.

**Pensacola hurricane, September 27, 1906. Baylen Street wharf looking southeast; also wrecked ship wharf across the slip**

The most severe eastern blizzard was probably the famous one of February 11, 12, and 13, 1899. The most remarkable feature of this unusual storm was that it affected a region of the country where mild winters are the rule and severe snow storms are decidedly the exception. The States to suffer most from the elements of this storm were Virginia, Maryland, Delaware and the District of Columbia. At Washington, D. C., the lowest temperature ever recorded in that city occurred—15 degrees below zero, and the snow was between two and three feet deep with drifts anywhere from five to fifteen feet in height. Records for low temperatures were broken all over the eastern part of the country, from the Gulf coast to New York City. The wind velocity during this storm did not exceed 40 miles per hour at any time.

In the West there have been so many severe blizzards with extremely low temperatures that it is difficult to pick out any one particular storm that was worse than any other. The great blizzard that swept over the Dakotas, Kansas, Nebraska, and Minnesota on January 11 and 12, 1888, was surely as severe as any. The storm swept down suddenly from the Canadian northwest, following a very mild day and without any warning whatsoever. Several hundred lives were lost and thousands of cattle perished. The wind blew at a rate of nearly 60 miles an hour, accompanied by a thick, blinding snow and a temperature around 20 degrees below zero. At Helena, Montana, the temperature fell fifty degrees in four and one-half hours. At Crete, Nebraska, it dropped eighteen degrees in five minutes.

The West and South is the home of tornadoes. They are without a doubt the most destructive and terrifying storm we have in this hemisphere and perhaps in all the world. Tornadoes come with such suddenness that there is absolutely no opportunity to give any warning. They last only a few minutes and disappear as suddenly as they begin. They occur most often from four to five thirty o'clock in the afternoon, which is generally the hottest time of the day. April, May and June are the months of greatest frequency. The States to suffer most from these death-dealing freaks of nature are Illinois, Missouri, Iowa, Kansas, Alabama, Georgia, Mississippi, Texas and southern Minnesota. Tornadoes never occur in any of the far western States. Indianola, Tex., was twice wiped off the map by tornadoes—first during the early summer of 1875 and again on August 19, 1886.

Most people do not have a clear understanding of the difference between a cyclone and a tornado. A vast system of winds blowing around a center of low atmospheric pressure is known as a cyclone. Many disturbances of this character pass across the United States at intervals of a few days, in a general direction from west to east. They are quite commonplace storms and as they approach the temperature generally rises. After they pass cooler weather follows with west and northwest winds. Sometimes these winds reach a high velocity, especially if a very high pressure area follows the cyclone. Very high northwest winds frequently follow these storms in the region of the Great Lakes, during the winter months, and quite often there is considerable damage done to shipping.

The most conspicuous feature of the tornado is a whirling black cloud, in the midst of a mass of dark storm clouds. This cloud is usually shaped like a funnel but at times looks somewhat like a balloon. Its action is similar to a waterspout. It sweeps over a narrow path never more than half a mile wide and often only an eighth of a mile in width. Wreck and ruin, death and destruction are accomplished by the terrific forces of the whirling winds wherever this funnel-shaped whirlwind sweeps the earth. These storms are purely local, while cyclones cover a very large area and travel for thousands of miles across the continent. Tornadoes are quite often called cyclones, but this is a mistake for they have no resemblance to a cyclone at all.

**Houses wrecked and the debris carried to the northeast by tornado at Binghamton, N. Y., June 5, 1905, at 10.30 P. M. This time of occurrence is unusual**

The West India hurricane is the other type of storm that causes great devastation. The West Indies and the Atlantic and Gulf coasts of the United States are the regions to suffer most from these storms. They originate way down in the West Indies, from whence they get their name. They only occur from July to October. Because of the splendid system of warnings established by the Weather Bureau these storms are always kept track of, and never arrive at our coasts without at least 48 hours' notice. They generally follow one of two courses—either up the Atlantic coast, or along the Gulf coast and thence inland, where they generally wane. The general character and formation of hurricanes is very much the same as that of the ordinary cyclones.

Galveston, New Orleans, Mobile, Charleston, Savannah, and Key West are the cities that have suffered most from the furious winds of the hurricanes. Unlike the tornado the wind of the hurricane gradually increases in force and lasts from twelve to twenty-four hours.

At Cape Lookout, North Carolina, there is no telling what the record force of the wind might have been had not the anemometer blown away after registering 138 miles an hour, during the fearful hurricane that hit that part of the coast on August 17, 1879.

There are other records of very high winds reported, namely 112 miles per hour was registered on Pikes Peak, Col., in January, 1881. At Cape Mendocino, Cal., in January, 1886, a gale of 144 miles an hour was recorded and at that point the anemometer blew away. Many Weather Bureau stations along the Atlantic coast have reported wind forces of from 80 to 100 miles an hour during hurricanes and winter storms.

Some of the temperature extremes that have been recorded in this country and at other places all over the world are most remarkable and surprising. At Ouargla, Algeria, on August 27, 1884, a temperature of 127.4 degrees Fahrenheit was registered in the shade. This is the highest temperature ever recorded. The lowest temperature ever known occurred at Werchogonisk, Siberia, on January 15, 1885, when the extremely low mark of 90.0 degrees below zero was attained. Other remarkably low temperatures recorded in Siberia are 80.5 degrees below at a place called Brascht, and 78.8 below at Merchmskoe. These towns, with such jaw-breaking names, are in a region where it is almost always perfectly calm, and that very fortunate fact helps to make the intense cold more bearable.

The ordinary mercury thermometer is of no use in recording extremely low temperatures, as mercury freezes at 37.39 degrees below zero fahrenheit. An alcohol tube is generally used in cold climates.

The lowest temperature ever recorded in the United States was at Poplar River, Montana, on January 1, 1885, where the low mark of 63.1 degrees below zero was reached. More recently, lumbermen and cattlemen of the Northwest have reported lower temperatures than that, but they cannot be relied upon as the thermometers used may not have been tested instruments.

Fort McDowell, Arizona, has the record for greatest heat in this country. At that place, in June, 1883, a temperature of 119 degrees was registered. Yuma, Arizona, is one of the hottest places on

(*Continued on page 190*)

### Is the Gasoline All Gasoline?

THE gasoline you use may contain impurities—possibly not, but the element of chance is never entirely removed. Not so with Uncle Sam who details the Petroleum Division of the U. S. Bureau of Mines to test all the gasoline used by the Government. If the product is not up to a high standard of excellence it is forthwith discarded.

The photograph illustrates Henry B. Cooke of the Bureau of Mines testing gasoline for the Post Office Department—hardly a retarding factor in the uncertain delivery of your mail! The apparatus, designed for this specific object, consists of a flask, electric heater, condenser, and accessories. A carbon residue instrument determines the quantity of carbon which remains after the oil is distilled to dryness. Another unit of the apparatus tells the time necessary for a certain volume of oil to flow through a specified capillary tube at a definite temperature.

The gasoline used by the Government—for example, the product employed in running the parcel-post motor trucks of the Post Office Department—is tested for the temperature of the initial boiling point and the final boiling or dry point. The results are compared with the figures specified by the Committee on Standardization of Petroleum Specifications, adopted for motor gasoline on November 25, 1919. If the fluid shows distillation temperatures above the standard temperatures at any point it is promptly rejected.

The instrument shown in the extreme right of the photograph is a closed-cup flash tester for determining the purity of kerosene and other oils. The U. S. Bureau of Mines will in the near future publish a bulletin describing the specially-designed instruments of Uncle Sam for revealing the quality of gasoline and oils used in the business of running the Government.—By *S. R. Winters.*

### Special Library Census

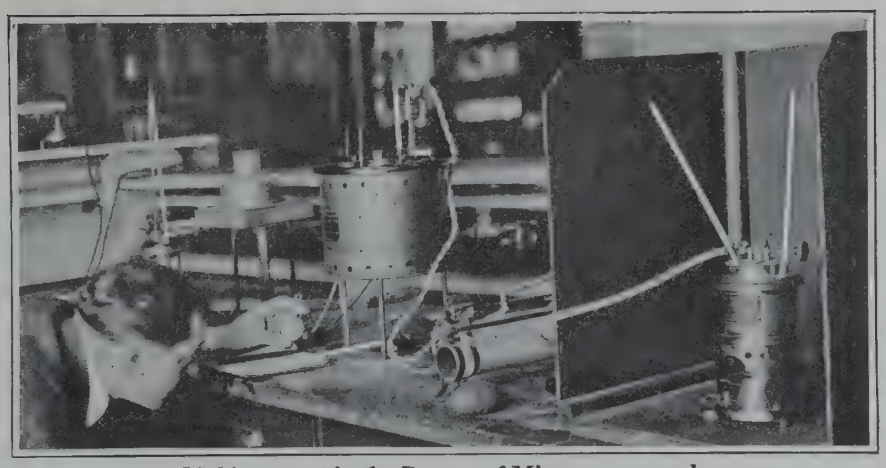
AT a time when the Government is counting up its inhabitants the Special Libraries Association is enumerating the special library collections of the country, because there does not exist at present an adequate directory of special libraries.

During the world war, when army camps and military centers were furnished with libraries for research and educational work, the men detailed to look up information for the Government were hampered by the lack of a satisfactory list of information centers which they might call upon for emergency assistance. Time and again army men could have used a directory of institutions or corporations having special information which they would permit them to consult, had such a publication been in existence.

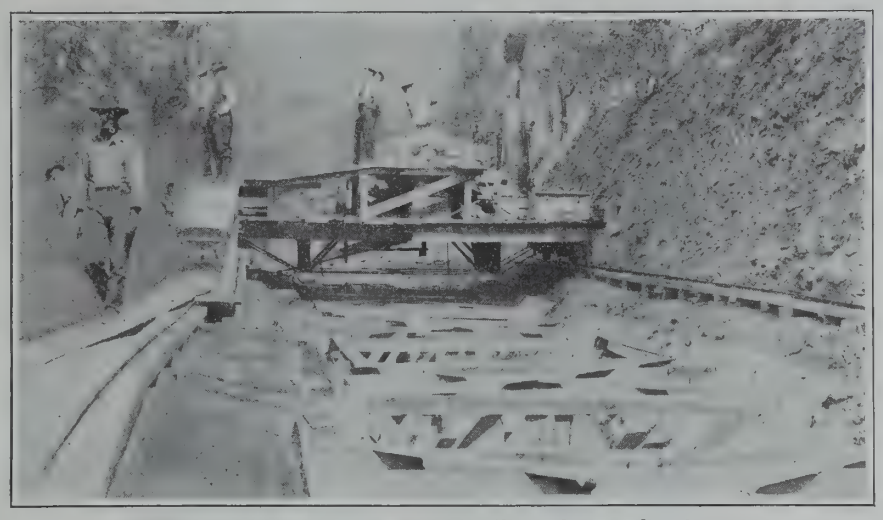
The business man realizes what it means not to have a directory of manufacturers at a time when he wishes to purchase a particular machine—and has no other way to go about it. His librarian is in just such a position when he or she is investigating a particular subject. Would it not be simpler if he or she knew of another library that had specialized on subjects of that type, and which had probably gone over the same ground?

When compiled, the directory will not be used as a mailing list for advertisers, but merely for the purpose stated, viz., to have in a central place a record of the special information sources of the country. A special library has been defined as:

"A good working collection of information either upon a specific subject or field of activity; it may consist of general or even limited material serving the interests of a special clientele; and preferably in charge of a specialist trained in the use and application of the particular material."

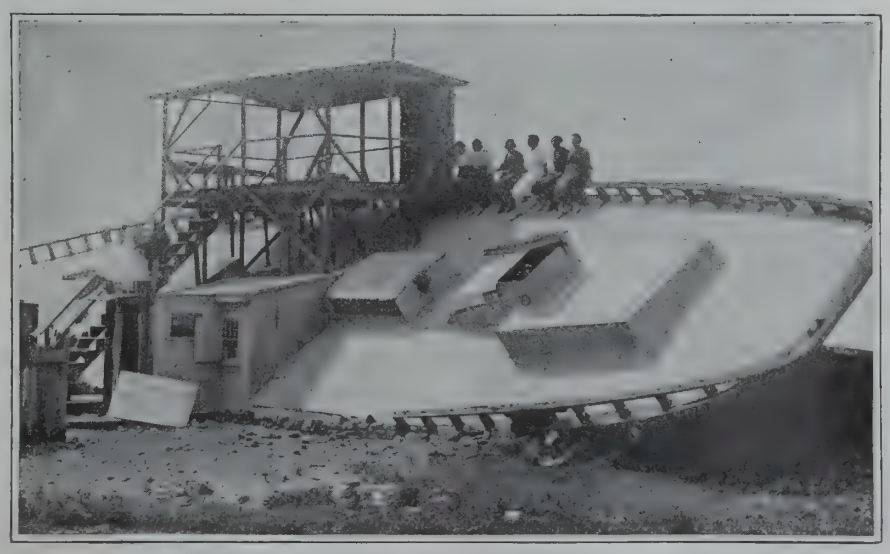


**Making a test in the Bureau of Mines on a sample of gasoline**



**This concrete plant travels on rails to the wooden forms**

**Fire resistive construction in a cotton warehouse, as it appears after a serious and widespread fire**



**This shipwreck has been converted into a summer camp with a seaside atmosphere**

If your library comes within the above qualications the S. L. A., will appreciate the following information from you:

Name of institution or company; name by which library is known; name of librarian or custodian; can it be classified as financial, business, legal, engineering, technical, institutional, municipal, reference, or agricultural; if it falls under none of these heads, the classification which you would apply to it; whether or not it serves a special clientele; would your librarian be willing to assist other special libraries to a reasonable extent?

The above data should be sent to Mr. William F. Jacob, Chairman Library Census Committee, General Electric Co., Schenectady, N. Y., who will be glad to answer any questions relating thereto.

### Wheeling the Concrete Plant to the Work

THE accompanying photograph shows a novel method employed in placing concrete lining for a canal. A track was built on either side of the ditch, and on this there was run a platform supported on four flanged wheels. On this platform there was mounted a donkey engine, and the concrete mixer. Portable inclines enabled the workmen to wheel the cement and crushed rock and sand on to the platform. When the concrete was properly mixed it was run through a wooden spout into the forms directly under the platform.—By *C. W. Geiger.*

### Saving the Warehouse When the Cotton Burns

FIRE resistive construction as applied to cotton warehouses has been developed to a high stage of perfection, to the extent that recently several of these buildings have withstood unusually severe fires which completely destroyed their contents without undermining or critically damaging the skeletons of the buildings themselves.

The initial cost of the reinforced concrete and steel system of construction followed in the building of fire-resistive cotton warehouses is high, but measured in terms of long-time wearability these storehouses are most durable and permanent. They are designed to favor the use of the most modern fire protective equipment and at the same time to withstand an intense and sustained fire. The accompanying photograph shows vividly how these buildings are able to resist the ravages of water and fire. Despite the fact that the entire stock of cotton was destroyed by a destructive conflagration, due to the excellence of construction and the permanency of the materials, the skeleton of the building is practically uninjured, the supporting columns, the walls, the floors and the roof, all weathering the extremes of heat, flame, smoke and water without seriously suffering from these damages or depreciation.—By *G. H. Dacy.*

### Putting the Wrecked Boat to Useful Work

AGAIN we reiterate the fact that in these days of housing shortage nothing in the way of shelter is permitted to go to waste. We add to our already large collection of makeshift houses the accompanying view of a wrecked ship—the pilot boat "Columbia," which was wrecked at Scituate, Mass., during the great storm of 1898. Some ingenious person saw an opportunity of converting that hulk into a museum and charging admission. At first the museum, containing relics of the sea and illustrating the story of "David Copperfield," was operated in this ship, but later the hull was used by a group of Boston girls as a summer camping spot. The hull is wired up with electric lights and is provided with windows and hatches for light and air.

# The Romance of Invention—XVI

## Charles G. Curtis—The Man Who Patented Efficiency In Steam Turbines

By C. H. Claudy

IT was years after the invention of the first steam engine before the idea was made practical for power purposes—literally hundreds of years. Hero, of Alexandria, is supposed to have been the first to make manifest the power of steam, his aeropile (a revolving boiler which obtained its revolutions by the impinging of jets of steam on the atmosphere) being at once the first steam prime mover and the first foreshadowing of the steam turbine of the nineteenth century.

Then, centuries later, came the steam cylinder, and for another two hundred years mankind forgot any other method of getting mechanical movement from the expansion of heated vapor of water. But there has always been the consciousness of a great waste and inefficiency in the reciprocating engine, and not all the efforts of all the inventors who compounded and duplexed, and who invented new and peculiar valve mechanisms, and more efficient boilers could get the piston and cylinder away from wastefulness.

Finally, inventors turned their attention to what is, perhaps, the oldest of all prime movers in the world—the water wheel, and considered if a steam prime mover might be made to work on the same principle. Came the first turbines, revolutionary in every sense, and a sharp division of this invention into two divisions—the De Laval type and the Parsons type.

De Laval evidently derived his idea from the undershot water wheel—that is, that the kinetic energy in the moving steam be made to give up its force by impinging upon the blades or projections of the rotor. In practice, a De Laval turbine makes a compromise between the ideal of turbine efficiency in this type—which would be reached if the speed of the blades or buckets could equal or nearly equal one-half the speed of the steam stream—and the limits of the strength of material, which forbids any such peripheral speeds as thousands of feet per second. In the De Laval type of turbine the steam expands at one jump from the full pressure of the supply to the pressure of the exhaust—it does this by being carried through a particular form of nozzle at the end of which the steam impinges on buckets in the rim of the rotor. But because the steam velocity (four thousand feet or more per second) is much greater than the possible velocity of the wheel, much of the kinetic energy of the steam stream is lost.

Parsons argued that if the steam were allowed to expand in many stages, instead of in one, and if each stage took its proportion of energy from the steam stream, a great gain in efficiency would be made—and he proved it with the Parsons turbine. In his invention, the drop in pressure is divided into many stages, and the buckets of the single wheel multiplied into thousands. Parsons also employs stationary blades so curved that the steam, winding in and out between moving and stationary blades, is made to give up energy by both its direct action or impulse and its reaction. And for many years it was thought that the Parsons type of turbine would prove the ultimate steam prime mover.

But then came Curtis with an entirely new conception of steam prime movers. Curtis believed that the De Laval principle of impinging a jet of steam on the bucketed edge of a rotating disk or wheel was the right principle. "Why not," he argued "combine the Parsons idea of steam expansion by stages, with the De Laval idea of steam impingement and the extraction of force by allowing moving parti- of steam to drive against resistance on a rotor? t have not one, but two or three or any de- r of De Laval wheels, each with its nozzle d so connected and so proportioned of steam stream to rotor speed is made economical and at the same time the least possible amount of kinetic energy is lost in the process?"

It is one thing to conceive an idea, it is another to put it into execution. Experimenting with steam engines in general and steam turbines in particular is a very expensive matter. Curtis did not conceive his invention as a drive for sewing machines—he dreamed of great installations for ocean liners, of huge prime movers on land for the generation of electric power, of great turbines which would displace the large reciprocating engines as power plants in factories. To build such an engine, even of modest size, is an expensive matter. To build it experimentally and try and change and alter and rebuild is still more expensive.

However, Charles G. Curtis has methods of his own. He is a believer in efficiency and a lifelong student of getting it, whether the thing in which it is to be had is a turbine, an electric motor, a factory or the disposition of his time. At the time his invention began to take form in his mind he was associated with Crocker (later Professor at Columbia) in the C. and C. Electric Motor Co. And it is interesting to remember that it was this concern which was responsible for the fan motor. Every artificial breeze which cools the offices and homes of the world today had its beginning in this company, which conceived and carried out the design for a small, cheap, silent and efficient electric motor for fan purposes.

In an experimental plant in Brooklyn Mr. Curtis spent some sixty thousand dollars in experimenting with his form of turbine. To invent anything is not particularly difficult. If it has any features of novelty it is not hard to get patents upon it. But as many an inventor has found, conceiving an invention and having it patented is one thing; selling it, putting it on the market, making it pay a dividend is quite another. But Mr. Curtis had something which the world wanted, and there were men in industry big enough to see it. So the land rights to the new idea in turbines were sold to the General Electric Company, which spent over three million dollars in developing the turbine to the point where it became commercial, that is to say, where its practical working and commercial manufacture could make its principles available for the production of the maximum efficiency in steam prime movers.

*INVENTORS are forever asking questions, and then going to work answering them. In fact, it is this matter of questioning the efficiency and desirability of existing things that makes for inventions, discoveries, progress. "Why not," argued Charles G. Curtis, "combine the Parsons idea of steam expansion by stages, with the De Laval idea of steam impingement and the extraction of force by allowing moving particles of steam to drive against resistance on a rotor?" This and other questions arose in the mind of Curtis. And proceeding to answer his own questions, he evolved his form of turbine, the Curtis turbine, which as a producer of power has a place all its own. But why tell about it here, when Mr. Claudy has undertaken to tell the entire story in the accompanying instalment of The Romance of Invention series.*—THE EDITOR.

**Charles G. Curtis, the inventor of the Curtis steam turbine which is widely employed in electric power plants and in marine propulsion**

It is difficult to express engine efficiency in percentages. Roughly the fuel or heat efficiency of an ordinary steam engine is less than fifteen per cent. That is, of the actual energy in a pound of coal, only about fifteen per cent is delivered in the form of available mechanical power. The reason is largely found in the absorption of energy in raising water from ordinary temperatures to the boiling point. During the expansion into steam so much latent heat is absorbed by the water in the process of turning into steam. There are also, of course, heat losses, and losses due to our inability to use all the kinetic energy in the steam. Could we utilize all the energy and have our steam escape from the exhaust of the reciprocating engine at no pressure at all—or even at atmospherical pressure—we would greatly increase efficiency, but to do this requires cylinders of such size and weight as are prohibitive in price and in friction produced. Every steam engine is a compromise between the maximum, theoretical, energy available and that which can be extracted with the greatest economy of friction, weight and expense.

The steam turbine has a higher efficiency than the reciprocating engine, the Parsons type has a higher efficiency than the De Laval and the Curtis shows a greater efficiency than the Parsons. But the advantages of the Curtis type over the other types are not only in a gain in efficiency but a gain in simplicity of construction and a great gain in practicability of use. A single point will illustrate this advantageously.

In the Parsons type of turbine there are literally thousands and thousands of steam buckets, both stationary and rotating. The clearance between them and the cylindrical casing must be very very small—in some cases as small as three hundredths or 1/33 of an inch. Make the clearance greater and there is leakage between the blade ends and the casing and an immediate drop in the efficiency of the extraction of power from the steam, for steam under pressure takes the easiest path and if it can escape *by* the blades, instead of weaving its way *through* them, it will do so, and expand without doing any mechanical work.

Now a clearance of three hundredths of an inch is a very small amount in a large turbine and the rotor and the casing must be most accurately made and again most accurately centered the one with the other, to permit the two to function with such a clearance. Consider, too, that expansion under heat must be taken care of, and that letting steam into a cold turbine too rapidly will expand the blades so that one or more may touch. This sounds innocent enough but actually it means wrecking the turbine, since the delicate blades, moving at high speed, need only a slight touch to bend over or break off, literally to churn themselves into small pieces.

In the Curtis type of turbine, where the steam is

(*Continued on page 191*)

## Soap from Clay—A Promise of British Chemists

SOAP from clay is the promise made by a group of British chemists who have been working on the utilization of this plentiful material for a number of years and who have just established the commercial usefulness of their discoveries. Their work is being described in a series of articles in a technical paper by Prof. F. C. Weston, a leading British authority on colloidal chemistry who has been in touch with their experiments.

Stripped of all technical verbiage what this group has discovered is a method of making use of China clay which is found in large quantities both in Britain and the United States, not as an adulterant, but as an ingredient in soap making. Soap, as most people know, is made now from fat and fat is scarce and expensive and is becoming scarcer and more expensive every year. China clay is plentiful and cheap. It can be had for the digging and the process of turning it into soap-making material is cheap and easy. It is claimed that it can be used up to fifty per cent in combination with the usual fatty acids in soap making and that the soap thus made lathers as well, is as cleansing and as pleasant to use as soap made in the old way of all fat. What this means to industry may be realized when it is stated that fats for soap making cost at present in England something like $200 a ton while the refined china clay can be produced and sold at an excellent profit for something like $75 a ton.

So far, the clays used have been from the famous Cornish beds but experiments with Georgia clays have demonstrated that they can be used equally well and no doubt there are many other clays in the United States that are equally suitable.

The process by which the clay is prepared is simplicity itself. After mining it is purified by a combined washing and chemical process and the resultant finely divided clay after being run into a settling tank is dried and is ready for use. It is a soft soapy substance without a trace of grit.

The purified clay has also been used in England in the manufacture of printing inks, for color striking, and a substitute for much more expensive chemicals in the vulcanization of rubber.

## Porcelain That Can Be Worked Like Glass

IT is well known both to the physicist and to the manufacturer that glass and porcelain behave very differently upon heating. While vessels of porcelain easily crack and burst and in consequence of this are not capable of taking a secondary alteration of form, most varieties of glass can be softened by heat and then bent, extended, or blown into the form desired. It is this quality of glass which is so useful to chemists and physicists in the laboratory and this is why glass is so greatly preferred to ordinary porcelain for the making of chemical and physical apparatus.

We learn from *Die Naturwissenschaften* (Berlin) that a Bavarian firm has lately succeeded in producing porcelain vessels which are highly resistant to changes of temperature. For the solution of this problem it was necesary to produce a glaze having exactly the same co-efficient of expansion as the mass of porcelain itself. In this way it was possible to obtain porcelain vessels highly resistant both to temperature and to fracture since the cracking and bursting of porcelain apparatus at abrupt changes of temperature is usually due to the creation of strains between the glaze and the mass as a result of unequal co-efficients of expansion of the two materials. These new porcelain vessels, on the contrary, can even have holes fused in their walls by an oxyhydrogen blow pipe without cracking. Moreover separate pieces of porcelain can be fused together exactly like glass, so that a porcelain tube, for example, can be fused into the wall of a dish. Finally this new porcelain can be softened and blown like glass. These qualities seem to assure it a wide usefulness.

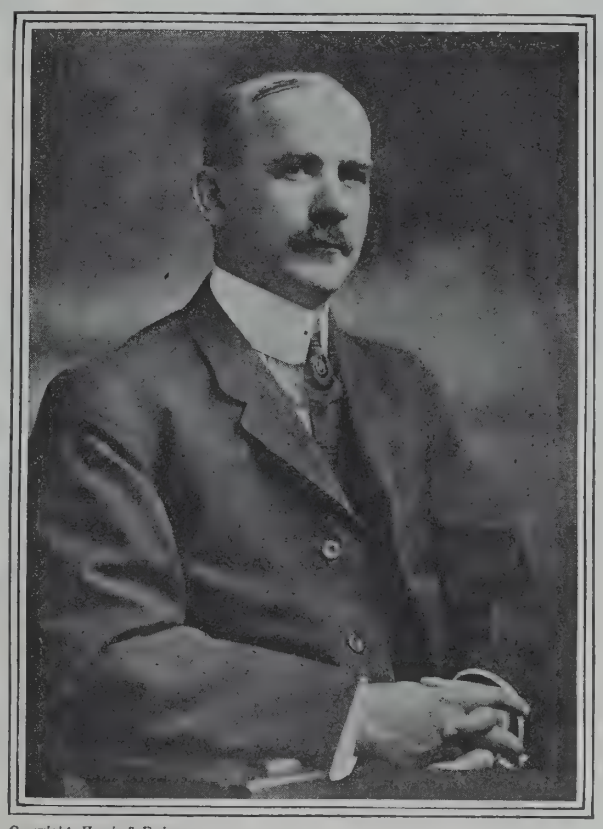
## Modern Version of the " Goose That Lays the Golden Egg"

A BRITISH paper prints the following interesting story regarding "Killing the Goose That Lays the Golden Egg." Nearly a hundred years ago Charles Lamb, in one of his whimsical essays, drew attention to the fact that many an old saw has in it a half-lie as well as a superficial truth. The idea that it is foolish to kill the goose that lays the golden eggs may in future be called in question as the result ot an experience which has befallen a farmer named Blackwood whose homestead is near Calgary. Blackwood killed one of his geese one day for dinner, and what should be in its gizzard but several gold nuggets. He proceeded to kill all his other geese, favorite and otherwise, and all the ducks, and the massacre yielded many additional nuggets. Naturally the discovery of gold-mining ducks and geese has led to a great rush of buyers of these birds. Thousands that have been roaming in the country adjacent to Blackwood's farm have been sold above par and are now "gone-west." Goose, with sage and onions, and roast duck are at a discount at the Calgary hotels, and a big rush of gold hunters or duck hunters is expected as soon as the new crop of ducks has a chance to feed up. Blackwood then scraped up a couple of shovels of black sand from his farm and took it to an analyst, who reported the sand to assay 18.30 grains of gold to the cubic yard.

## The New Commissioner of Patents

FURTHER evidence, if any were needed, that the Government is not competing successfully with large private and corporate interests for the services of the best men, is furnished by the resignation of James T. Newton, Commissioner of Patents, to take charge of the American business of a prominent British firm of patent solicitors. He is succeeded by Robert F. Whitehead, the thirty-third to hold this office since its creation.

Mr. Whitehead's home is in Lovingston, Nelson County, Virginia. He is a graduate of thē University of Virginia, and has had also a two years' course in



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**The new Commissioner of Patents**
**Hon. Robert F. Whitehead**

mathematics and physics at Johns Hopkins, one of the cradles of American science. After teaching school for five years, he entered the patent office in February, 1902, at the bottom of the examiners' ranks. He advanced steadily through the various grades, finally being appointed law examiner. In May, 1914, he graduated into the distinctively executive class through his appointment as assistant commissioner, and in June, 1916, he received the rank of first assistant. He is a member of the bar in addition to the regular qualifications to be expected of a successful patent examiner, and has been admitted to practice before the District Courts and the Supreme Court of the United States. He was married in 1904.

Mr. Whitehead will take up the duties of the Commissionership immediately upon his return from a vacation in Maine. His record is such as to inspire every confidence in his ability to take up the administration of the patent office at the point where Mr. Newton has left it, and carry forward the excellent work of his predecessor.

## Alcohol Obtained from Coke-Oven Gases

WHILE in these prohibition days the possibility of obtaining alcohol from coke-oven gas in large quantities may not appear apropos nevertheless there is a practical phase which demands attention because of the prospect in relation to the motor fuel supply of the future. According to a paper read before the Cleveland (Ohio) Institution of Engineers the importance of this source of alcohol appears in the fact that one ton of coal yields 1.6 gallons of absolute alcohol. Thus the possible gain of alcohol from the coke-ovens of this country is 23.4 million gallons a year. If the gas-works were to recover their possible ethylene an additional 27,000,000 gallons would be available. This would leave the situation for motor-spirit as follows: Gas-works, 34,000,000 gallons of benzol and 27,000,000 gallons of alcohol; and coke-oven plants, 30,000,000 gallons of benzol, and 23.4 million gallons of alcohol; total, 114,400,000 gallons against 160,000,000 gallons required.

It was clear from the outset that whether charcoal or sulfuric acid was to be used in the purification, the recovery of ethylene and the manufacture of alcohol derivatives could not be made to pay unless the fuel expenditure was cut down to a minimum. This end is attained by utilizing waste heat. The point has been raised that with the removal of the ethylene from the coke-oven gas the calorific value of the gas will be seriously lessened. An investigation of the question has shown that when all is taken into account this loss of calorific power is negligible—only 1.1 per cent. Hence it is evident that the heating of the ovens will not be seriously affected. The processes described involve no new principle. The reactions are well known and therefore may be accepted without discussion. All that is claimed is the application of these reactions to industrial practice in the preparation of cheap alcohol from coal.

There are, however, certain new features in the carrying out of these processes, which features make for the success of the system.

## Effects of Manure Scarcity

ONE of the big subjects among Boston market gardeners nowadays is the question of location. Up to the advent of the motor truck, market gardens to supply the Boston demand were automatically kept close in, and as the available area of suitable land was limited it commanded a very high price, while its control placed the owning or renting gardener in a strategic selling situation. The motor truck tended to drive the market gardens farther out, and now there is another much talked of factor, the scarcity of stable manure.

The scarcity of stable manure, a consequence of automotive displacement of the horse, grows more and more serious. The heavy Boston supply, which formerly liberally supplied the market gardens, has fast diminished. Its further curtailment is anticipated. On any intensively cropped land, fertilization is a vital matter, and with stable manure supplies cut off, an immediate remedy is imperative.

It seems certain that entirely new fertilization methods will come into use. One method seriously considered at this time involves the use of gardens of larger size considerably farther out, trucks being relied on to get produce to market in time. Larger farms would enable the gardener to grow crops for green manuring, which, with the aid of artificial fertilizers, would meet the problem. The Rhode Island Experiment Station has conducted tests along this line which indicate it is practical, using green manures and chemicals, to dispense with stable manure in large part, or wholly.

This is a strong argument for the removed location, and there is just one serious objection to it. That is the labor question. Italian labor is mainly depended upon by Boston market gardeners. The laborers will work at a point reached by a short trolley ride, but refuse to go farther out. The consequence is that despite the stable manure shortage, recognized as permanent, Boston gardeners are still somewhat at sea over the question of location.

## New Application for Metal Spraying

THE metal-spraying process appears to have found a new application in engineering practice, according to an article in a German technical paper. It seems that the sand contained in the water jets supplying Pelton wheels may pass through the finest screens and still be sharp enough to destroy the buckets. Observation has revealed the fact that the sand-blast does not remove lead covering from iron, and it is therefore proposed that buckets for Pelton wheels should be lead covered by means of the so-called spraying pistol, in which a lead wire is fed automatically into an oxy-gas blowpipe and sprayed as a fine cloud of molten metal by the force of the gases. Lead applied in this way adheres very firmly to iron and steel as the minute particles are projected with great force and actual metallic contact is obtained, which is not the case when ordinary dipping processes are employed. Presumably the lead forms a sort of amorphous surface layer sufficiently elastic to counteract the erosive action of the sand particles.

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In a full line including

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a 5-ton truck
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THE PRESENT LINE *retains* these distinctive Pierce-Arrow characteristics—durability, long life, easy operation.

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Pulling Power—equal to any demand

Gasoline Economy—more miles per gallon

Accessibility—for quick economical repairs

THESE ARE PRIMARY FACTORS in operation and maintenance—the true test of truck economy.

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48 of the FIRST FIFTY trucks still running after 9 years' service.

Delivers more work in a given time.

Loses less time on the job and off the job.

Costs less to operate and less to maintain.

Lasts longer, depreciates less, commands a higher resale price.

THE PIERCE-ARROW MOTOR CAR COMPANY, BUFFALO, N. Y.

# The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

*This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles*

**Special body adapted to the delivery of ice cream**

## Speedy Ice Cream Delivery

EVERYONE has observed trucks or wagons with loads of cracked ice and freezers of ice cream standing in front of a drug store or soda fountain and no doubt has noted the stream of water running over all under parts of the truck. This is particularly hard on the springs, frames and other smaller parts under the body.

An ice cream company of Milwaukee operates two two-ton trucks with bodies well adapted for this work. Three compartments, metal lined, are provided for ice or containers and another for salt. Partitions can be set in in order to facilitate the handling of brick ice-cream or regular freezers. Space is left in the center of the body which enables the driver to unload large containers with ease. Drain pipes lead from each compartment and these carry all water well below all the truck parts. A truck has just been purchased by another concern for this work, this one to have pneumatic tires for speedy delivery, which is shown in accompanying illustration. This also has a special body for carrying the ice and is fitted with drip pipes so the corrosive, salty water will not leak out of the body at points where it can collect on the machinery. The special body construction illustrated not only saves the truck mechanism from untimely depreciation but greatly facilitates the handling of the ice cream containers and the speedy delivery service is greatly appreciated by the trade.

## Repair Shop Trucks for Fleet Owners

MOVING repair shops, mounted on motor trucks, which were extensively used by the Government during the war to care for its large fleets of trucks at home and abroad, are destined to play an important part in facilitating the successful operation of the ever-increasing fleets of trucks operated by large companies, contractors and road builders throughout the country. With the increasing use of fleets of trucks in various lines of business, the machine shop truck, as a flexible medium for keeping fleets of trucks in constant running order, at a minimum loss of time, will become as necessary and vital a factor for commercial use as it was during the war.

The continuous operation of every truck is an important consideration with a fleet owner and in this respect the machine shop truck has proved itself a time and money saver through its ability to go direct to the crippled truck and put it in shape at a minimum of time. Mounted on the chassis is complete equipment to handle any kind of repair job. A separate motor furnishes the power for operating the various machine tools. This embraces such mechanical apparatus as a drill press, screw cutting lathe, electric grinder, blow torch, welding outfit, forge and more than 1,000 other pieces of machinery and tools.

Each tool and piece of machinery has its own location, insuring compactness when the end and side panels are up and the truck is in motion. The fact that a great number of these moving repair shops were furnished the Government during the war is proof of their value in caring for fleets of trucks. With the increasing tendency to operate fleets of trucks in various industries, the efficiency of the machine shop truck will soon make it an important factor with every fleet owner.

**A complete motion-picture equipment is carried in this large truck**

## Motorized Open Air Theatre

MOTION pictures on wheels is one of the latest developments designed by Messrs. De Pathy and Bergstrom of Hartford, Conn., the apparatus for which is shown in the accompanying photograph. In this motorized open-air theater bus are a motion picture machine, equipped with a 32-volt gas-filled lamp, a 1-kw., 40-volt, 1,700 r.p.m direct current generator and miscellaneous equipment. The generator is driven by a fabric band on the engine flywheel. The pictures are projected through an opening in the rear of the bus on a screen 40 or 50 feet distant, which may be stretched on any convenient building or between posts and trees. The owners intend to visit small towns and villages which do not support moving picture theaters, yet which have sufficient population to support an occasional performance. The expenses of operation will be materially reduced over that of running even a small theater and a regular route can be established so the latest thrillers will be brought to an amusement-loving public who would otherwise be deprived of this popular means of recreation. The truck is decorated in bright colors and serves to advertise the enterprise.

## Motor-Driven Wagon Loader

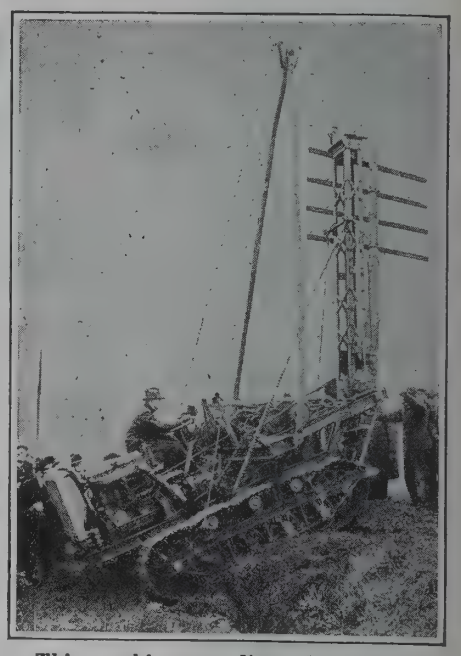
THE accompanying illustration shows a useful piece of machinery for coal dealers, contractors and others who use motor trucks for hauling such materials as sand, loam, crushed stone, coal, etc., which must be loaded from piles on the ground to trucks. The machine is a bucket type conveyor, the chain of buckets being driven by mechanism mounted on the loader chassis. Either an electric motor or a small gasoline engine may be used as a source of power for the conveyor to suit individual requirements. The conveyor mechanism is arranged so it can be adjusted for materials of various kinds and for different sizes of piles. Gearing is provided so the conveyor can be fed into the pile by its own power. The wheeled truck makes it easily moved. Needless to say, a machine of this nature will replace a considerable number of men at a marked saving. This combination of two familiar elements—truck and conveyor—is plainly a very happy one, and one that adds much to the utility of each. The independent source of power for the conveyor is a particularly good feature, since it makes it unnecessary to connect and disconnect between truck engine and driving gear of the conveyor each time the truck is filled and replaced by another.

**The motor-driven loader saves much time in operating a motor-driven fleet**

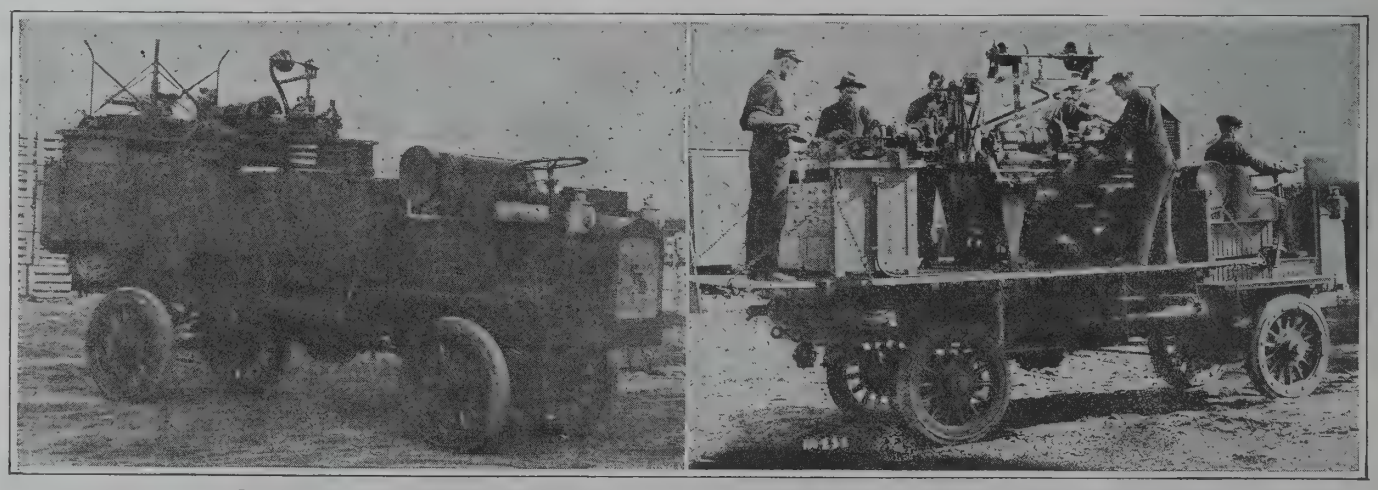
## Combined Tractor and Earth Boring Machine

THE accompanying illustration shows a field test on a recently devised traction engine which carries an earth boring machine used in drilling post holes. The machine proper consists of a structural iron frame carrying a shaft on which a large post hole auger is mounted. This can be fed down into the ground to make a hole of the required depth. This auger, which is carried on a vertical shaft is driven by chains and gears from the main power plant. The engine is the usual four-cylinder, overhead valve type that is very popular for tractor work and transmits its power to an auxiliary transmission controlled by clutch levers placed conveniently to the driver.

The entire mechanism is mounted on track laying traction members which not only makes it possible for the machine to maneuver exceptionally well on soft and rough ground but it also provides a large area of ground support for carrying the heavy propelling and earth boring mechanism. The frame carrying the auger can be set to drill holes at any desired angle when the machine is level, or to drill straight holes if the machine is tilted, which is inevitable if the machine is on a bank or high hill. The tractor not only carries arrangements for boring the post holes expeditiously but also has a triangular derrick boom so it can be used for setting the poles after the holes have been made for their reception. The value of a machine of this kind and its labor-saving possibilities can only be appreciated by contractors who have undertaken the task of setting out miles of pole lines by the usual methods.



**This machine expedites the work of boring post holes anywhere**



**The moving repair shop as it looks when on the go, and the same truck set up ready for work**

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.*

## Of General Interest

FOLDING UNIVERSAL TABLE.—A. W. LEE, Rockwood Hale, Tarrytown, N. Y. Among the objects of the invention is to provide a folding table of light and simple construction and having its parts so positioned and arranged that the table, when not in use may be folded to occupy but little space and will have its various parts carried therein. The table is particularly intended for use in automobiles or vehicles and for campers, the legs are adjustable and all movable parts are held firmly in position.

MOP HEAD.—I. M. KAUFMAN, 601 Howard Ave., Brooklyn, N. Y. The object of the invention is to provide a simply constructed mop head in which the principal feature is the adaptability of the mop head to thick or thin mop cloths. The device comprises a frame, a cloth holding bar rotatably mounted to receive varying thicknesses of cloth, and means for clamping and holding the bar in position.

FOUNTAIN BRUSH.—W. GRACE, Hellabys Bldg., Queen St., Auckland, New Zealand. The invention is adapted to be embodied in brushes for various purposes, such as toothbrushes, shaving brushes, shoebrushes and the like. More particularly the invention relates to a fountain brush involving a reservoir or container adapted to receive a replaceable refil cartidge containing plastic or other material to be delivered to the bristles, feed means being provided to cause the paste or other material to be extruded as required.

SALVAGING APPARATUS.—C. SANGER, St. Louis, Miss. The invention relates to the salvaging of sunken vessels and the like. The prime object is to provide a tank capable of being submerged by filling the same with water which is subsequently discharged from the tank to render it buoyant. A further object is to so construct the tank that it contains suitable means for discharging the water and means for controlling the discharge.

APPARATUS FOR TEACHING ARITHMETIC.—R. A. JACKSON, Springfield, N. J. The object of the invention is to provide an apparatus for enabling teachers of arithmetic to readily test the scholars as to speed and accuracy in solving arithmetical problems. Another object is to provide a simple apparatus arranged to disclose a great range of arithmetical problems in addition, subtraction, multiplication and division, and to permit the teacher to quickly change from one branch to another and to vary the problems.

HOSE REEL.—G. L. PERRINE, Hillsboro, Ore. The invention has for its object to provie a device wherein the hose may be permanently connected with the source of water supply while on the reel, to permit as much of the hose as may be desired to be withdrawn from the reel for use without interfering in any way with the flow of the water. The reel might be used in connection with air hose as well as water hose.

YOKE OR SHOULDER WEIGHT CARRIER. R. P. ORR, 35 So. Manning Blvd., Albany, N. Y. This invention relates to weight supporting means for the shoulders of a person and has for an object the provision of a construction adapted to fit against the shoulders in such a manner that the weights connected therewith will be supported evenly over the entire shoulders, the arrangement being such that weights may be positioned so as to be supported by either shoulder or both shoulders simultaneously.

CARRIER RECEPTACLE.—R. P. ORR, 35 So. Manning Blvd., Albany, N. Y. The object of this invention is to provide a carrier receptacle with a number of compartments which may be easily supported while at the same time arranged to present easy access. Another object is to provide a carrier receptacle for mail carriers, soldiers, and other parties desiring an easy means for carrying one or more articles.

JUVENILE PRINTING BLOCK.—CAROLINE MONTEITH, 117 Scotland Road, So. Orange, N. J. The object of the invention is to provide a printing block for teaching children or beginners to read without the usual formal exercises by utilizing the natural activities and powers of children as they play and the art of printing their own reading material.

TAILORS' ORDER BLANK.—H. C. DIXON, Lodge No. 946, Protective Order of Elks, Tulsa, Okla. The invention has for its object to provide a blank of the character specified which, in addition to a complete record of the customer's measurements, will furnish one or more photographic views of the customer in order that the tailor may have before him a photograph showing the physical peculiarities of the customer.

ENVELOP.—W. HIRE, 297 Glendale Ave., Detroit, Mich. The object of the invention is to provide an envelop formed from a single piece of material so folded and secured as to provide a plurality of separate pockets, the specific arrangement of which is that they are adapted to contain different matter for mailing such as catalogues or circulars, it being possible to use circulars and catalogues of different sizes, which will reach their destination at the same time.

APPARATUS FOR EXTRACTING GREASE FROM ORGANIC MATTER.—K. A. STAHLGREN and T. L. SHANNON, address Thos. L. Shannon, 19th and Providence Ave., Chester, Pa. An object of the invention is to provide an apparatus for extracting grease from garbage and other organic matter in an exceedingly simple and economical manner. Another object is to provide a large heating surface for effectively heating the organic matter and at the same time insuring a thorough agitation of the matter and the solvent used to reduce the time of drying the organic matter and extracting the grease.

BELL RINGER.—L. LA MUNYON, Shoshone, Idaho. The invention relates more particularly to a construction and arrangement of striking device which may be utilized in connection with a bell, such as a fire alarm, an object being to provide a hammer which comprises a leaf spring and to which an oscillating movement is imparted causing a rapid and continuous vibration of the free end of the hammer.

FRUIT PITTER AND CUTTER.—W. N. RISDEN, Watsonville, Cal. An object of the invention is to provide a simple apparatus which will at a single revolution of the drive shaft operate to sever or cut the fruit in half and at the same time cleanly cut out the pit of the fruit. Another object is to provide a device which can be manufactured and sold at a reasonably low price.

FOLDING BOX.—P. A. HOFFMAN, c/o Smead Mfg. Co., Hastings, Minn. The invention relates to folding or knock-down boxes and more particularly to a folding box used for the mailing of currency and valuable securities, such as bonds, notes, mortgages, etc. The general object is to provide a folding box which can be variously folded to produce different capacities of receptacle whereby the box may be made to exactly and tightly fit its contents. A further important object is to provide for the proper sealing of the ends.

EYEGLASS CASE AND CLEANING DEVICE.—R. A. GOELKEL, 601 W. 137th St., New York, N. Y. The object of the invention is to provide a combined eyeglass case and cleaning device, whereby substantially any sized or shaped eyeglasses may have the lenses wiped while still in the case by a member having a rotary movement which is transmitted to the glasses so as to move the same over suitable wiping surfaces.

CAMERA.—K. CHEN, 75 Baikal Road, Shanghai, China. This invention relates more particularly to cameras of the reflex type, and has for its principal object to provide means whereby in case of necessity a wide angle lens may be employed. The invention aims to make the use of a wide angle lens possible by providing a slotted opening forward of the mirror to receive a ground glass in a frame for focusing, or in its place a conventional plate holder.

SWAGGER STICK.—E. L. YUNGK, 9 Elliott St., Hartford, Conn. An object of the invention is to provide a toy novelty which will be attractive in appearance and which will have an appealing influence upon holiday and festival occasions where celebration is engaged in by people of all classes. A further object is to provide a toy comprising what is known as the swagger stick and an audible tone-producing device and decorations.

HEEL.—A. H. SOMMERS, 225 Hamilton St., Allentown, Pa. This invention relates to fastening means for effectively securing the heel to the shoe. An important object is to provide a device of this character especially

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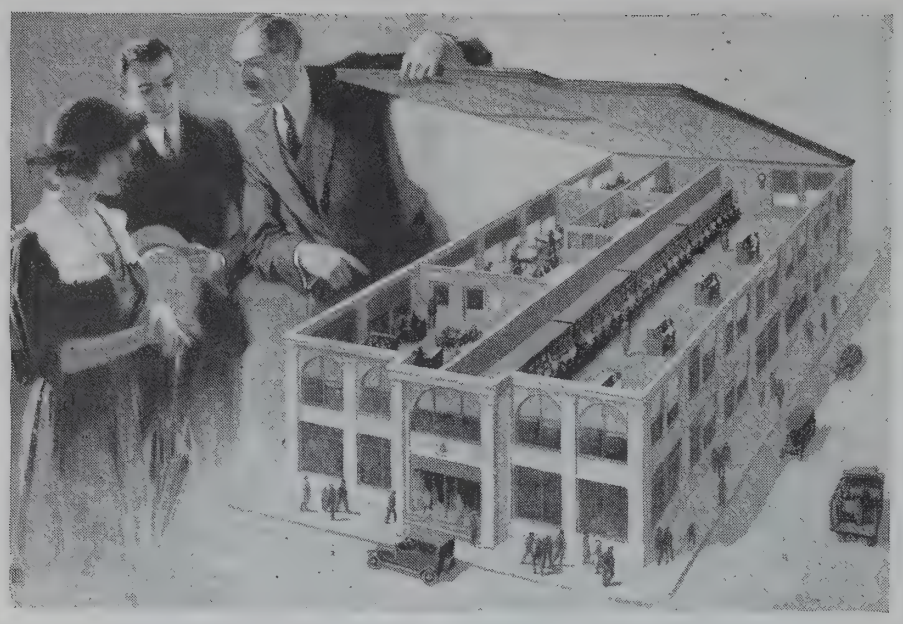

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### Machines and Mechanical Devices

HYDRAULIC MOTOR FOR CHURN OPERATING DEVICES.—A. Roos, 1432 W. Monroe St., Chicago, Ill. An object of the invention is to provide a simple device by means of which water, as, for instance, that derived from a village water supply, may be utilized for operating the churn. A further object is to provide an adjustable device to meet the varying conditions of churns of different sizes or heights, and rooms of different sizes. The device is simple, having few parts, and therefore not liable easily to get out of order.

CAM AND PUSH ROD MACHINE.—J. Holle, 389 So. Belmont Ave., Newark, N. J. This invention relates to a cam and push rod mechanism for puppet valves and other devices and has for an object a device wherein a greater throw is provided by the same type of cam. Another object is the provision mechanism so arranged that the push rod will engage substantially flatwise against the face of the cam, and as the parts move the same will gradually move off the push rod on to the roller so that the push rod may return in easy manner over the rounded rear surface of the cam.

### Pertaining to Vehicles

VEHICLE SPRING SHACKLE.—J. J. Crawford, West New Brighton, S. I., N. Y. The object of the invention is to provide a spring shackle more especially designed to connect the eyes of a pair of semi-elliptical leaf-springs with each other and arranged to act as a shock absorber and to guard against breaking of the spring members. Another object is to absorb the minor vibrations and jolts incident to the vehicle running over rough roadways.

TRACTION WHEEL.—O. R. Hanson, Cadogan, Alberta, Canada. This invention relates more particularly to traction engines, whose wheels as now formed have broad flat treads, the object being the provision of simple means capable of ready adjustment to the wheels for the purpose of generally improving traction with either hard or soft ground, or traction surface which may be readily installed and which is capable at all times of efficient action and ready repair.

LOCK FOR TIRE CASINGS.—T. E. Cook and A. T. Freije, Rincon, N. M. This invention relates to locks for tire casings, and has for its object to provide mechanism to be used in connection with wheels having clencher rims for locking the shoe or casing to the rim in such manner that it cannot be removed by unauthorized parties. To prevent the removal of the casing a plate is provided which is shaped to fit upon the adjacent edges of the casing, within the same, to hold the edges of the casing from inward movement and thus prevent displacement.

VEHICLE.—L. Nussbaum, address Henry Shade, Quail and Elk Sts., Albany, N. Y. This invention has reference more particularly to an impellent ice or snow vehicle which includes runners with a frame made to accommodate an occupant who may thrust or push the same ahead by an impeller or the like. The primary object is to provide a simple, durable vehicle which may be manufactured at a low cost.

TEMPERATURE INDICATOR FOR AUTOMOBILE RADIATORS.—W. F. Jenkins, 1814 Hanover Ave., Richmond, Va. Among the objects of the invention is to provide an indicator which will exhibit a column of steam to the driver of the automobile immediately the radiator begins to boil, and to provide a radiator cap with means whereby the steam will be exhibited, so that the driver will be informed either in the day time or at night of the fact that the water is boiling.

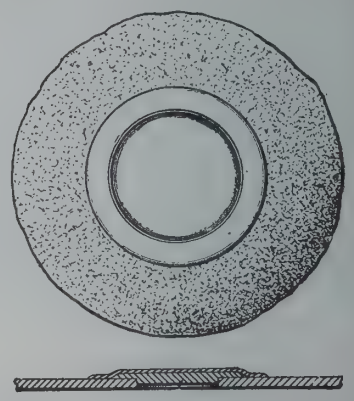
REBOUND CONTROLLER.—H. G Craig, R.F.D. No. 5, Washington Court House, Ohio. This invention has for its object to provide a device adapted to be arranged between the frame of a vehicle and the axle for controlling the rebound to prevent shock and jar, wherein the arrangement is such that the device offers no impediment to the compression of the spring, but cushions the expansion, and wherein the cushioning action may be varied.

TRACTOR WHEEL.—C. A. Slocum, 534 Milwaukee St., Denver, Col. The invention relates more particularly to a tractor wheel comprising a revoluble but rigid inner member surrounded by a revoluble but flexible outer member, the latter being so arranged that by distortion of its shape while in action it will spread out upon the ground and thus give a relatively large bearing surface, and consequently a better tractile effect.

TRAILER.—F. B. Allen, Joplin, Mo. The general object of the invention is to provide a trailer having a longitudinal bearing through which is disposed a guide pole adapted to be articulated to the rear of a truck, draft means being secured to the pivot of a bolster on the trailer and being adapted to be secured at the pivot to a bolster on the truck.

BICYCLE PUMP LOCK.—A. P. Lundin, 1491 *a* Xitchner Ave., Bey Valley, Johannesburg Transvaal, South Africa. A particular object of the invention is to provide a locking means permanently secured to one frame bar of the bicycle and positively locking the pump thereon to prevent unscrupulous removal. The device is so constructed that it will positively engage the pump and will automatically move out of engagement when the lock is opened by a key.

PROCESS OF VULCANIZING.—T. A. McAllister, 586 Broad St., Augusta, Ga. The invention relates to a process of vulcanizing, as for instance in the repair of pneumatic tubes and the like wherein it is impracticable



A TRANSVERSE SECTION AND PLAN VIEW, SHOWING THE PROCESS COMPLETE

or undesirable to place a backing of vulcanized rubber on the reverse of the tube to be repaired. The process consists in cementing to the outer face of the tire a sheet of vulcanized rubber and in placing raw rubber on the outer face of the sheet and vulcanizing the rubber.

EMERGENCY TIRE.—H. M. Shannon, Richmond, Tex. An object of the invention is to provide an emergency tire adapted to be quickly and easily applied to the automobile rim. Another object is to provide an emergency tire having high cushioning properties closely approximating the qualities of the pneumatic tire, the construction and arrangement being such that the device may be cheaply and easily manufactured while preserving strength and durability.

TRUCK.—J. T. Hall, 317 No. 11th St., Waco, Tex. This invention has for its object to provide a truck especially adapted for railroad use, as for instance, in handling baggage, freight or the like, wherein the supporting wheels are so arranged with respect to the body that they may be moved longitudinally thereof to permit the end of the truck to rest directly on the ground in loading, or to raise the body of the load well above the ground during transportation.

### Designs

DESIGN FOR A GEM SETTING.—W. Fischer, 67 Courtlandt St., New York, N. Y.

DESIGN FOR AN ARTICLE OF MANUFACTURE.—A. Flint, 267 5th Ave., New York, N. Y.

DESIGN FOR A PENNANT.—A. E. Langlois, 121 Hathaway Ave., New Bedford, Mass.

DESIGN FOR A BADGE.—D. E. Victor, 505 5th Ave., New York, N. Y.

DESIGN FOR A PURSE.—C. A. Nichthauser, 32 Union Sq., New York, N. Y.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## Is There a Coal Shortage?

*(Continued from page 174)*

All these things have heaped coals of fire upon the heads of the men who are responsible for the coal supply of New York's public utilities. Said one executive:

"I used to pay no attention to the coal problem excepting once a year when we renewed our contracts. Now I have to be constantly on the alert to prevent a shut-down of our system."

Realizing the delicate position of New York's public utilities with regard to a coal supply, and the terrific consequences of a shut-down, the Interstate Commerce Commission has granted priority to coal shipments to these concerns. For the present, at least, their coal problem seems solved and responsible executives say they have no fear of a coal famine next winter, unless some new circumstance intervenes.

All of this, however, takes no account of the industries which are served with coal that comes to or through New York. These present quite a different problem.

Few industries buy as much coal or as steady a supply as do the public utilities. As a result they find greater difficulty in buying coal at all and far greater difficulty in having it delivered. Such fuel is subject to seizure by the carriers and great quantities of it never reach their destination.

As a result, many of the industries have pooled their coaling facilities. Not only do they buy through a common agency, but they exchange coal among themselves by common agreement. Thus the manufacturer who has an excess of coal will come to the aid of the man who has none.

One such association, the Tidewater Coal Exchange, handles about 1,250,000 tons of coal monthly. The exchange was formed during the war to facilitate the handling of coal, as a patriotic measure, and has been continued as the beneficial results became apparent.

The Exchange classifies all coal coming to it and each classification is numbered, such as Pool No. 16 or No. 25. Members establish a credit by shipments to a certain pool or pools and they may then draw upon these pools for their supply. In special instances and in emergencies they may draw their coal from the pool before their shipment has actually arrived, or they may even draw out more coal than they have credit for. Credit in one pool may be transferred to another. The arrangement, on the whole, is a very flexible one and has practically eliminated the coal troubles of the firms who are members.

The greatest advantage of this arrangement, from the standpoint of the public, is that the movement of coal cars is greatly expedited. Cars do not have to stand on sidings until the consignee can unload them, but they are unloaded by exchange employees and the cars are immediately returned to the mines. A system of inspection and supervision is maintained by the exchange to protect the shipper and to speed delivery.

Officials of this institution say they are having no difficulty now in buying coal at the mines. As in the case of the public utilities, the principle difficulty is in transportation.

The general impression that a serious coal shortage exists or impends is no doubt fostered to a large extent by the abnormally high prices the householder and the small user of coal have to pay. The wide discrepancy that exists between the cost to very large consumers, and the cost to small users suggests that there is room for investigation. The basic costs are the same in each case. That is, the costs at the mine, haulage costs and insurance do not differ for coal users large and small, in the same locality. But the fourth item of expense—*profit*—may vary widely.

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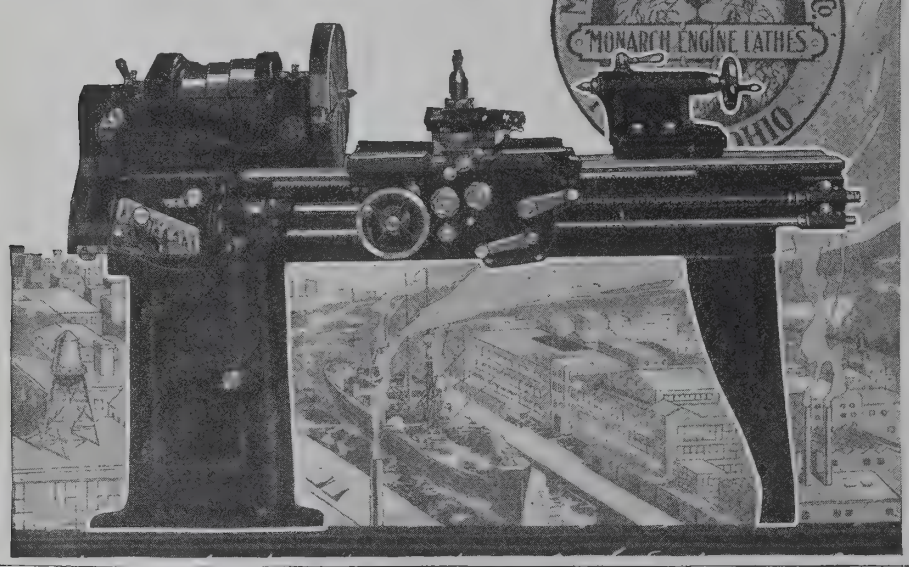


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are supplied almost exclusively by the large mines, the profiteer, if he exists, is usually the small miner and his victim is the small user of coal.

Undoubtedly a factor in the price of coal is the large export demand. The mines of northern France once supplied a large part of her coal. These mines were flooded by the Germans and even so long after the armistice only one or two mines have been able to get into operation. The recent Allied demand indicates that the German mines are not being operated at capacity. England needs all of her coal and to meet reconstruction needs is importing more. As a result the United States is meeting an entirely new export demand. High prices can be obtained for this coal. It is said that in Paris coal is selling as high as $100 a ton.

Already there is a movement on foot to place a Governmental embargo on exportations. Undoubtedly such a step would improve domestic conditions, both as to supply and price of coal.

It has also been charged that coal cars which were diverted from their usual routes last winter to meet unusual conditions have never been returned and are being used to haul other materials.

On the whole there appears to exist a tension in the coal industry, based on the fear that "something is going to happen," rather than anxiety over present conditions. But it is almost the universal opinion of New York coal buyers that there will be no coal famine next winter unless some link of the chain breaks under the strain.

## An Engineering Bulwark

(*Continued from page 176*)

pated; such a budget will eventually effect economies in governmental activities that will be reflected in decreased taxation in which each citizen is vitally interested.

The creation of The Federated American Engineering Societies and its governing board, the American Engineering Council, is a matter of public interest, in that a trained body of several hundred thousand men will be available for the service of the public in those questions which affect the economic position of this country in the world as regards the economic administration not only of the government but of the state and of the community.

As an example of the service such an organization can render it may be stated that at the conference between the members of Engineering Council and Vice-President Marshall of the Senate and Speaker Gillette of the House of Representatives, Engineering Council proffered its services on matters upon which engineering advice of a disinterested character might be helpful, and Vice-President Marshall, in accepting, stated that this unusual and generous offer would be referred in writing to the Drafting Bureau, a new bureau of the Senate which has charge of the preparation of legislation.

The Federated American Engineering Societies will speak for a group of citizens which, by reason of special training and knowledge, represents a high order of intelligence and will provide a medium by which the talents that these citizens possess can be applied individually and collectively and unselfishly for the common weal.

## Record Weather

(*Continued from page 180*)

earth, and frequently reports temperatures near the 110 degree mark.

A couple of hundred of miles or so northwest of Calcutta, India, is a place called Cherra Punji, which is the very wettest spot in all the world. Here the annual rainfall averages about 38 feet—458 inches. The wet season there is during the summer months when nearly 300 inches of rain falls every year. The summer average is approximately three inches per day. During some of the particularly heavy cloudbursts they have in that region, there are records that show that as much as 30 inches of water have fallen from the clouds in 24 hours. June 14, 1876, holds the record for wetness, for on that day just 41 inches of precipitation was recorded. The year 1861 was the wettest year on record in that locality—900 inches of rain fell during the twelve months beginning with January, 1861.

Just as a matter of comparison it might be well to state that the average annual rainfall of our own metropolis of New York City, which we consider sufficient for all good purposes, is about 45 inches. There have been other remarkable rainfalls in this country and in other parts of the world.

At Vera Cruz, Mexico, nearly 200 inches of rain fell during a twelve months period a few years ago. At Neah Bay, Washington State, 140 inches of moisture fell from June, 1865, to June, 1866. At Upper Mattole, Cal., 41.63 inches was recorded during the month of January, 1888. At Alexandria, La., 21.4 inches fell on June 15, 1886.

A remarkable downpour of rain took place at Washington, D. C., on July 26, 1885, when .96 of an inch fell in the space of six minutes. This deluge descended from a heavy thunderstorm.

The extreme southern end of Florida and the southern California coast are the only sections of the United States where snow has never been known to fall. There have been slight flurries at various times in every other part of this country. At Punta Rassa, Florida, only a hundred miles north of Key West, snow fell for a few minutes on December 1, 1876. At San Diego, Cal., snow flurries occurred in January, 1882. But snow never lays on the ground south of the thirty-third parallel of latitude—which passes through the central portions of Georgia, Alabama, Mississippi, Texas and southern Arizona and New Mexico.

Heavy snowfalls have occurred in many parts of the Rocky Mountains—at Circo, in the mountains of northern California, 20 feet and 11 inches of snow fell during the month of March, 1882. In Wyoming and Idaho and Colorado there have been some remarkably heavy falls of snow during the winter and early spring months. It is not at all unusual for portions of those States to be buried under two or three feet of snow from a single storm lasting perhaps for a day or two. It takes several months of warm weather to melt the great masses of snow that cover the ground in some of these western and northwestern States.

Heavy falls of snow occur also in the Alps of Italy and Switzerland and other mountainous regions.

Summer snowfalls are unusual, and only a few have ever been officially recorded in the eastern part of the United States. In high altitudes and in the Far North they are not uncommon, but in this region they are.

At Colebrook, New Hampshire, in July, 1883, there was considerable of a snow flurry, lasting for five or ten minutes.

At Lynchburg, Virginia, there was a slight fall of snow on June 12, 1887. As recently as June, 1907, snow was reported to have fallen at Fredericksburg, Virginia—but there is no Weather Bureau observer at that place and no official report was made of this occurrence.

On July 12, 1888, it snowed quite heavily in the region of Mount Washington, N. H., and during the month of July of that same year snow fell in small quantities over parts of England and Scotland.

Weather records show many freaks and unusual meteorological conditions that have been recorded from various parts of the world that are most interesting and remarkable. Forecasting and studying the weather is most fascinating and absorbing, and scientists have made great progress along these lines during the past 30 years. That any degree close to perfection may be reached in making weather

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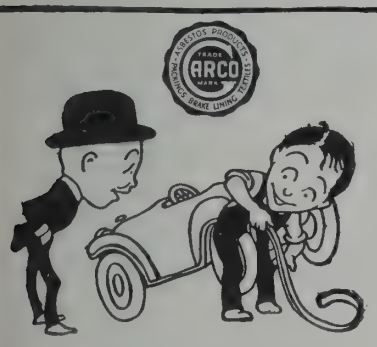


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forecasts is doubtful, for there are always certain elements and atmospheric conditions that may suddenly and unexpectedly arise that will change entirely the course of a storm or the movement of a cold wave. As an example that can be easily understood,—many storms form in the region of the Gulf of Mexico, and move northeastwardly to the south Atlantic coast, when they may continue in a northeast direction along the coast or they may pass out into the Atlantic Ocean, without causing any precipitation or winds along the coast. Sometimes, when conditions seem to favor the storm's passing out to sea, it will continue its northeastward movement and shoot up the coast—or vice versa, as the case may be. It is an even bet as to just what course these storms will take and it is doubtful if the weather experts will ever reach such a state of perfection that they can unfailingly predict which way these southern storms will move. However, there can be no doubt or question raised as to the splendid work performed by the Weather Bureau, and its value to the business and agricultural interests of this country.

### The Romance of Invention—XVI

(*Continued from page 182*)

allowed to rush from nozzles against buckets, the clearance may be amply sufficient to permit any degree of expansion of metal no matter how hurried—a quarter of an inch clearance is entirely practical. At one step, then, the Curtis type gets rid of many difficult details of construction. Again, in the Parsons type of turbine, what is known as a "dummy ring" must form a part of the turbine, this being a steam-tight joint between drum and casing, in which steam is kept from escaping along the shaft by a series of rings, each fitting in a slot of peculiar shape on the end of the shaft and requiring accurate end adjustment. There is no necessity for such a device upon the Curtis, because the steam does its work by expanding at the nozzle and the leakage of steam between the several chambers in which are the several rotating elements is not sufficient to make any material difference in the efficiency of the whole.

Control of speed in a turbine is as important as control of speed in any other form of steam engine. Here the Curtis is highly efficient, because speed is controlled, not by throttling down the amount of steam which enters the working chamber from the steam line, but by cutting off the supply of steam from one or two or more nozzles. Those nozzles which remain in action operate at full efficiency, but when two nozzles are presented with the problem of developing the work usually done with four nozzles, they accomplish of course, but half as much. Were the steam left in all four nozzles ("two" and "four" are used here diagrammatically, there may be many more in an actual turbine) but reduced in pressure by the throttle, none of them would work efficiently, and while speed would be reduced, cost of operation would not be reduced in proportion. The maximum Curtis turbine efficiency is found when the full force of the steam pressure is allowed to rush from nozzles against buckets. The maximum Parsons efficiency is found when the full force of the steam pressure enters the high pressure chamber. To reduce a Parsons turbine in speed, the pressure must be reduced. To reduce a Curtis turbine in speed the number of nozzles in use are reduced but the pressure in any nozzle remains the same.

It is difficult to say whether the Curtis turbine has been a greater success on land or at sea. Some five million Curtis turbine horse-power are in use in the British Navy, as much more in our own. Altogether there is over twenty million Curtis turbine horse-power in ships at sea or now building. The amount of Curtis turbine horse-power at work on land in the United States alone is over fifteen

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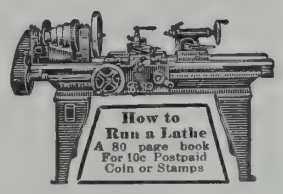


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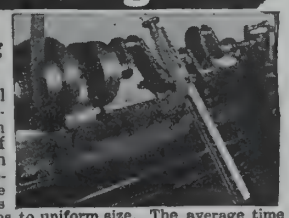

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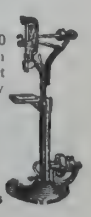

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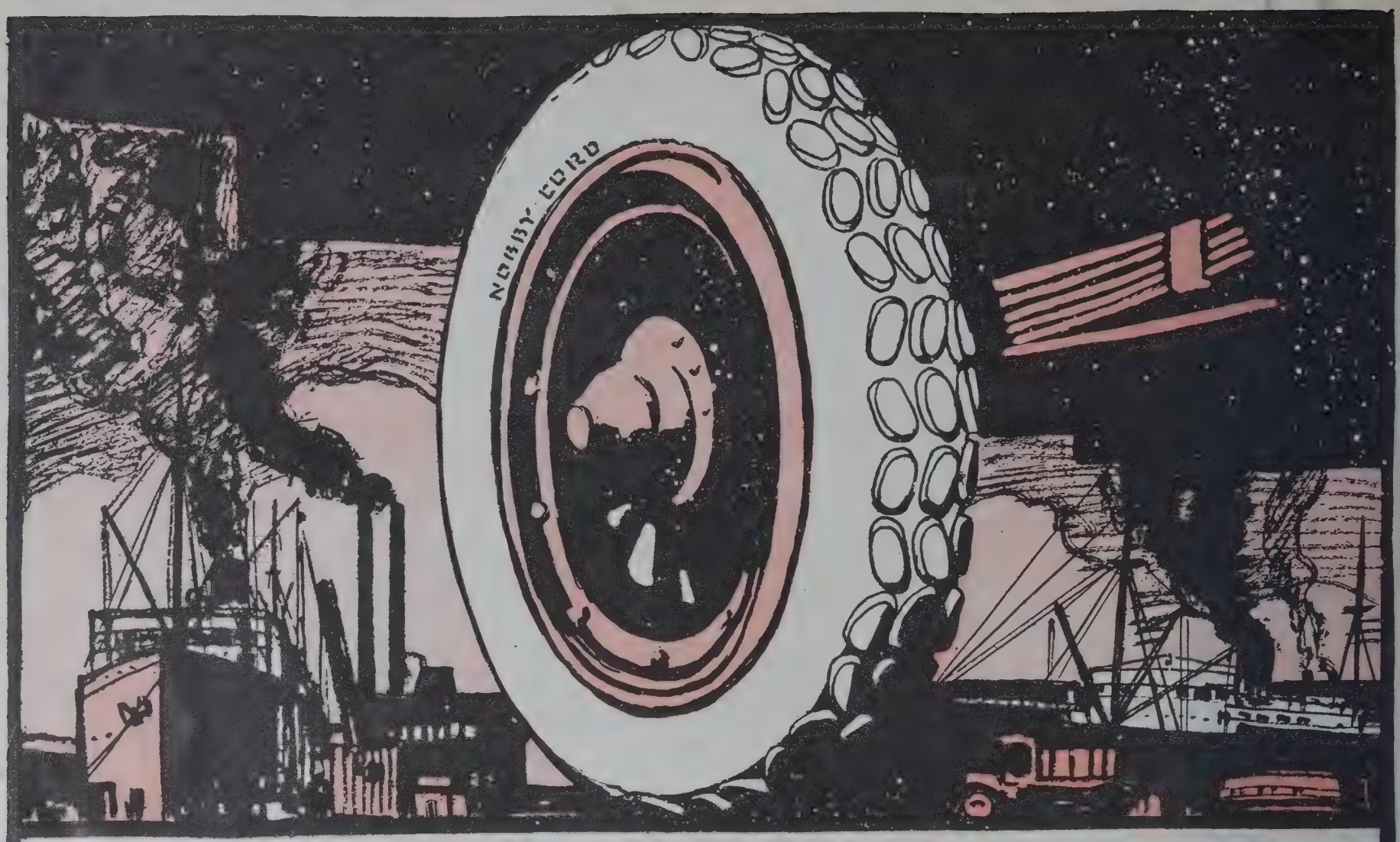


# A NEW TRANSPORTATION ERA-
## BUT WHAT KIND OF PNEUMATIC TRUCK TIRES

NINE years ago, there were only about 25,000 motor trucks in the country. That was when *the first pneumatic truck tire ever built* came out of one of the U. S. Tire factories.

How changed today. More than 700,000 trucks. Over 5,000 truck *lines*, paralleling the service of the railroads. More starting daily.

The United States Rubber Company has long been preparing for this new transportation era. Looking ahead—realizing the part the *right kind of pneumatic truck tires* should play. Thinking of the *food* situation, the *industrial* situation—*every* phase of commercial transportation.

Its years of experience—longest of any truck tire manufacturer—have been devoted to this one objective: the construction of a *Truck* Pneumatic built for *Truck* service. With the result that it has been able to incorporate, in each U. S. Nobby Cord Pneumatic Truck Tire, a structural strength beyond anything ever attempted—as may be seen from the way its beads are *anchored*, its breaker strips *multiplied*, its flap *moulded*, its side cushions *bulwarked*, its holding to the road *made sure*.

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The United States Rubber Company is providing truck owners *today* with the pneumatic truck tire performance they will be looking for when the *bulk* of the nation's freight business is being done by motor truck.

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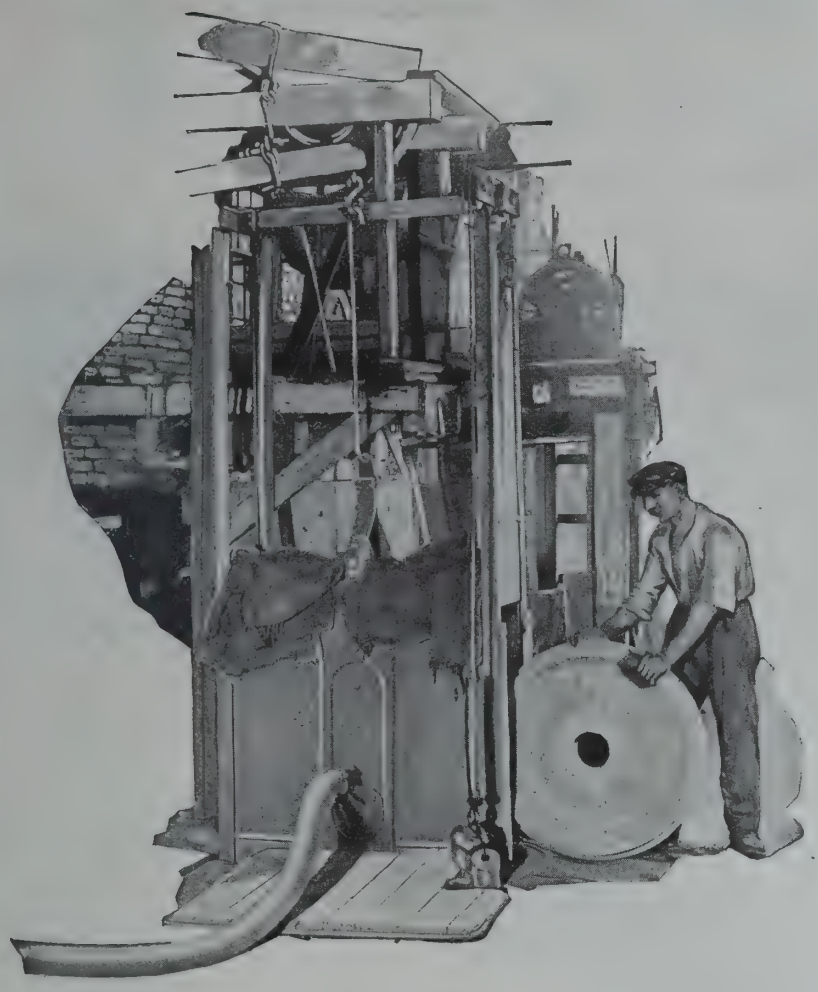

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*Rainbow Sand Blast Hose* has repeatedly outworn heavy iron nozzles. Its special pure gum tube resists injury and abrasion from sand far better than any other tube.

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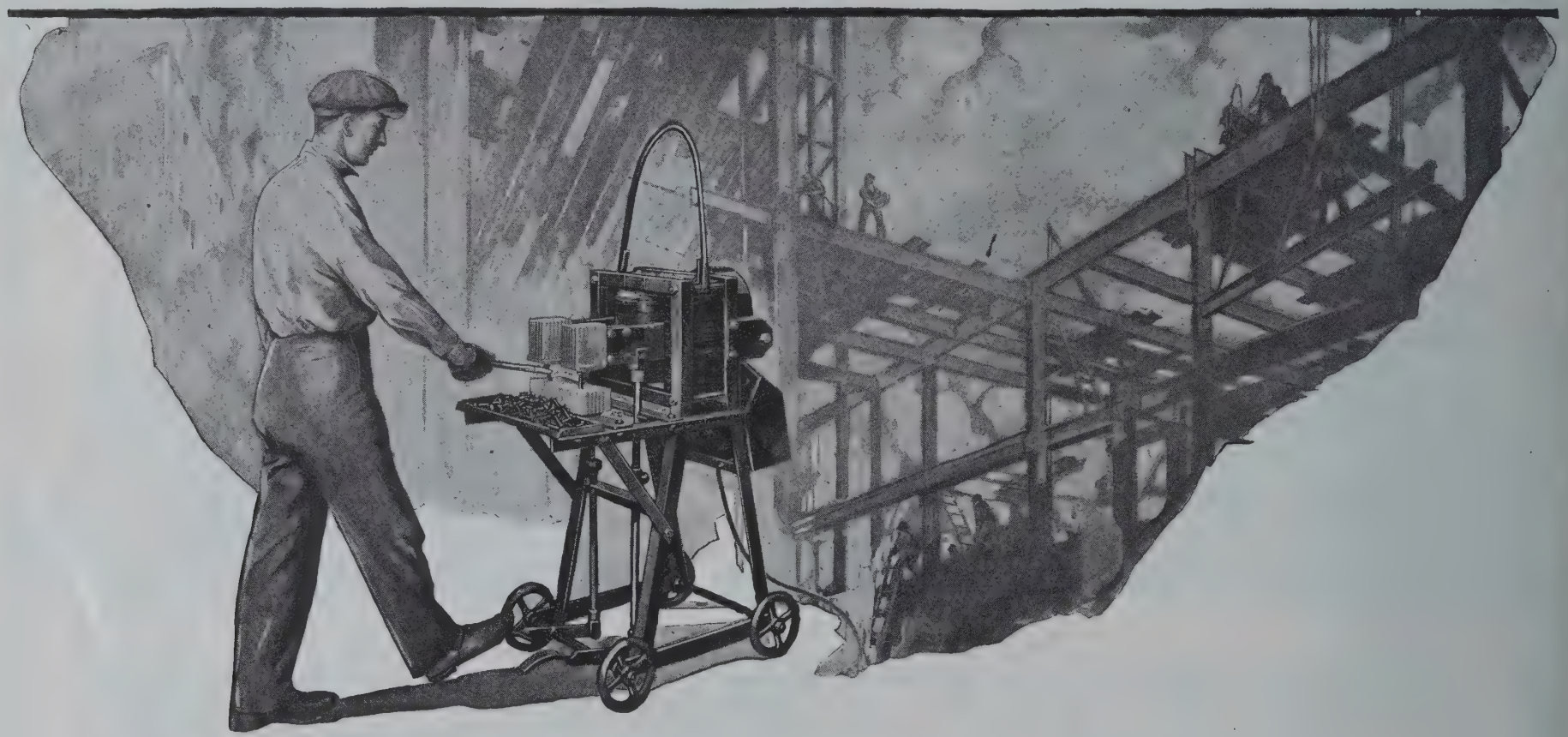
Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

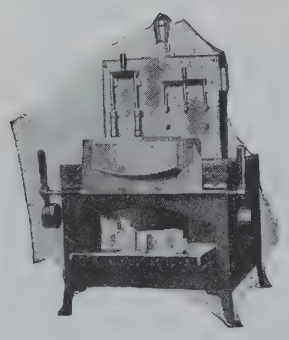
*Among the many benefits derived from forced production of war time, there is none more lasting or more promising than electric heat*



# 800 Red Hot Rivets per Hour

*Soldering iron muffle furnace*

*Electric soldering iron*



*Muffle type heat treating furnace*

WHILE the nation's shipbuilding program was in full swing, every day demanded rivets, more rivets and still more rivets. And the electric rivet heater helped shipbuilders to establish records that are now history.

This portable heater was carried to every corner of the ship, connected to a wire, and in a few seconds red hot rivets were supplied at a rate as high as 800 per hour, depending upon the size. No coal, no dirt, no cinders to bother with, no smoke and gas to irritate the workers — just a steady, uniform heat that works from the inside out, making the rivet shank hotter than the head, with the minimum of scale, fewer spoiled rivets and *current consumed only when rivets are in the jaws.* No wonder this ingenious device has won such wide-spread recognition in such a short time.

Performance of this kind is typical of the G-E electric heating equipment in a variety of industries. From the big electric ovens which bake the enamel on an automobile body with perfect results, down to the electric soldering iron which allows the man of the house to mend a leaky saucepan, the usefulness of electric heat is making itself felt in practically every place that heat is required.

The fact that electric heat is so simple to control, so accurate, so quick, and so safe under all conditions, makes it a vital necessity in some fields and a much desired improvement in others, regardless of its initial cost. This, together with the almost boundless resources of the General Electric Company in research as well as experience, insures the prospective user absolute reliability if he calls upon G-E to satisfy his heating requirements, large or small.

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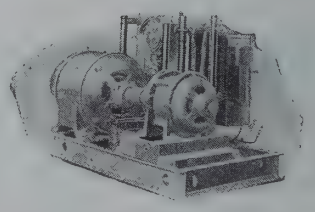

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SEVENTY-SIXTH YEAR

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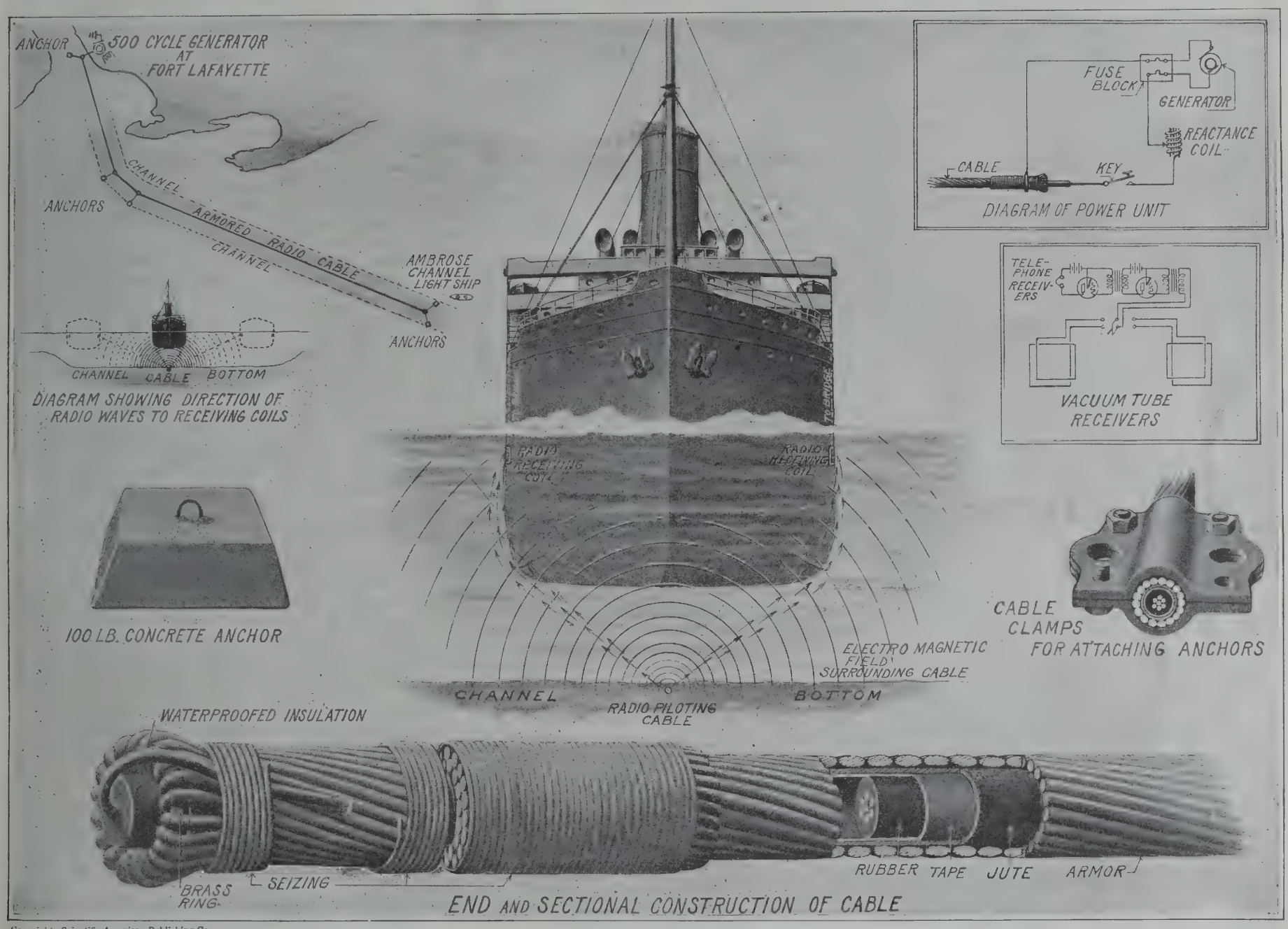


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**Details of the radio pilot cable which is to be laid along the route of New York's incoming and outgoing shipping**

## New York's Radio Pilot Cable

**By George Gaulois**

MUCH has been written about the electric cables used during the war for the purpose of piloting ships in and out of harbors at night. Indeed, it now appears as though this system of navigation is one of the greatest benefits derived from the war, and one that is just as important in peacetime as in war. However, with the installation of such a system in New York Harbor by the United States Navy, it is now possible to give exact details of how the radio pilot cable operates.

In brief, the principle of the radio pilot cable, as it is called, is to employ a cable through which flows alternating current. Ships intending to use the cable while passing in or out of waterways are provided with a pair of coils which intercept the electromagnetic waves emanating from the cable. By noting the relative strength of the waves reaching each coil, it is possible for the ship's navigator to determine when he is astride the cable. Once riding astride the cable, it is relatively easy to follow it along and thus steer a correct course. In certain installations two cables are laid, each carrying a current of a given frequency. Ship navigators can tell which is the incoming and which is the outgoing cable by making careful note of the sound of the waves. In this manner a route is provided for ships going in either direction, and the chances of collision are reduced to a minimum.

In the New York Harbor installation, which will follow the Ambrose Channel, one type of cable has been specified. This cable consists of seven strands of No. 16 tinned copper wire insulated with a layer of 30 per cent Para rubber 3/16-inch thick, over which is wrapped a layer of tape and jute, impregnated with a water-proof insulating compound. Over this layer of jute is an armor which consists of a wrapping of No. 12 galvanized steel wire. The overall diameter of this cable is approximately one inch. Some 87,000 feet of cable will be required.

There will be two anchors secured to the extreme end of the cable and only one anchor will be used at each of the three other points along the cable.

A one-killowatt motor-generator will be used for supplying 500-cycle alternating current to the cable. The voltage may be either 125 or 250 volts. Provision will have to be made for driving this generator from local source of current supply so as to maintain the motor-generator set at a constant speed. It is obvious that a fluctuation in the speed of the generator results in a change of note, which is apt to cause much confusion when using the cable. The amount of current flowing in the cable will be under control at all times and will range from one to eight amperes. A telegraph key is to be installed for the purpose of

(*Continued on page 210*)

# SCIENTIFIC AMERICAN

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**New York, Saturday, August 28, 1920**
**Munn & Co., 233 Broadway, New York**

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## To Preserve a Beautiful and Historic Work

THREE-QUARTERS of a century ago a great American engineer, J. B. Jervis, built across the Harlem River, as part of the original Croton Water Supply, a handsome masonry aqueduct which stands today as one of the few remaining fine examples of the engineering work of its time. The High Bridge viaduct was built to carry the Croton aqueduct across the deep gap near the northern limits of the city through which flows the Harlem River. It consists of a series of round arches supported upon massive piers, two of which stand squarely in the navigable channel of the river. In that early day, the traffic through the Harlem River was light; but the river piers have come to form a very material obstruction—so great, indeed, that the United States War Department has demanded their removal.

With the construction of the new aqueduct which passes beneath the river by a large syphon, the old aqueduct has ceased to have any immediate use; and various plans have been suggested to deal with the resulting situation. The city's Department of Plant and Structures advocated the complete removal of the bridge; but the Department of Water Supply urged that the bridge be preserved as an emergency reserve.

Now the aqueduct is historically valuable as being a fine example of the early work of American engineers. John B. Jervis, who built it, was the chief engineer of the Croton aqueduct at that time and his claim to recognition and remembrance is enhanced by the fact that it is he who was the constructive engineer of two other great engineering projects, the Erie Canal and the Hudson River Railroad. Artistically considered, the Croton Aqueduct has always been regarded as one of the ornamental structures of magnitude in a city which possesses all too few works of this character.

We are glad to know that the American Institute of Consulting Engineers has taken this matter in hand and that they have drawn up a plan which aims to combine the new and the old parts of the structure in a way that will preserve the harmonious beauty of the whole. It contemplates the removal of two of the piers and the replacing of the three arches by a single arch of a flattened, semi-circular outline, with a clear height equal to that of the other round arches and a clear span of 231 feet. The interior of the structure will be built of reinforced concrete; its exterior will be clothed with the dressed stone removed from the old arches and piers which are to be replaced. As a consequence of this the face of the finished structure will match the rest of the bridge in the weather-stained appearance of its masonry and will harmonize perfectly with the tone and color of the whole bridge. Furthermore, an illustration of the reconstructed bridge shows that this central arch of wide span will relieve the monotony due to the constant repetition in the old bridge of arches of equal or approximately equal span, and that it will add greatly to the dignity and general architectural fitness of the whole work.

This meritorious suggestion should command the hearty approval not only of the authorities but of every citizen of greater New York. For not only will it preserve to the city a reserve aqueduct which, in case of emergency, might prove to be of greatest value, but the engineers have found that they can widen the top roadway and utilize it as an additional automobile driveway between Manhattan and the Borough of the Bronx, at a point where for over a mile there is no street connection between the two sides of the river. In its plea for the perpetuation of this structure by changes which will add to rather than detract from its beauty, the committee reminds us that the design of the aqueduct places it in the same class as the famous Roman aqueducts, the remains of which are among the chief attractions of the old world.

## "By Their Fruits Ye Shall Know Them"

WILL the day ever come when a discerning public will accord to the civil engineer the tribute of gratitude and perpetual remembrance which is surely his due when he conceives and puts through masterpieces of engineering construction? Is it not a reflection upon human nature that only in the rare cases when the engineer happens to be also the financier of a great undertaking, does posterity associate his name with his work? Too often the master mind which conceives a noble engineering project, solves its many problems as they develop, carries the burden of its multiplied anxieties, and transmutes his great dream into a splendid reality—too often he passes out of the public mind, and his name and fame are known only to the comparatively limited number who grace his own profession. Henceforth his masterpiece is associated with the name of the promoter and the financier, and to them accrue the rewards and financial profits.

A notable case in point is that of the distinguished engineer, J. B. Jervis, whose name, honored in the records of the civil engineering profession, is probably forgotten, if it were ever known, by the great world that for three-quarters of a century has enjoyed the benefits of his work. To think of the Erie Canal, of the Croton Water Supply, of the Hudson River Railroad, is to think of Governor Clinton and of that unique genius, Commodore Vanderbilt, not of Jervis. Mention of the Suez Canal brings to mind and always will De Lesseps; but De Lesseps was financier as well as engineer. The Panama Canal, to be sure, will be associated with the name of General Goethals, but he himself, doubtless, will tell you that, backed by the influence and wealth of the United States Government, he merely applied great organizing ability to the carrying out of a plan that was formulated and developed by men whose names have already, so far as the Canal is concerned, passed into obscurity. Foremost among great engineering works is our original New York subway system, the work of William Barclay Parsons; but, except for a commemorative plate in one of the least-used of the local stations, there is little to remind us how greatly we are indebted to this engineer for solving the problem of rapid transit at a time when the city was threatened with unparalleled congestion.

There are, of course, notable exceptions, prominent among which is the beautiful suspension bridge across the East River—to think of the Brooklyn Bridge is to think of Roebling. But among the millions who have crossed and will continue to cross the great Forth Bridge in Scotland, how many recall the fact that the construction of this majestic work was due to the fine vision and daring of Benjamin Baker. True it is that, following an admirable precedent, Baker was rewarded with a baronetcy, a practice which is common among the older civilizations. Our prejudices prohibit the granting of such rewards; but we cannot but feel that in some other way a means might be found to perpetuate in the minds of a so greatly enriched posterity the memory of the men who, in the routine of their honorable profession, have the imagination to conceive, the courage to suggest, and the ability to carry through works of the first magnitude.

## The Scope of Common Law Trade-Marks

THERE are two features of American trade-mark law which are not adequately understood by the majority of trade-mark users. One of these is that trade-marks are not property in the sense that we ordinarily give the term. The right to use a trade-mark is something that can be established in this country only by its exercise; the source of the trade-mark right lies ultimately in the use of the mark, and not at all in the official document that certifies this use to be a matter of public record.

The second point to which we would advert is that trade-marks are not under the entire control of the Federal Government. Acting under the provisions of the Federal Constitution which delegate to that Government exclusive control over all matters affecting foreign and interstate commerce, Congress has passed certain acts applying to trade-marks. But trade-marks are as old as the common law. Small manufacturers, who to all intents and purposes restrict their business to the State in which they are located, may adopt trade-marks, and having by using these marks established their right to use them, may through the State courts protect these rights in the State.

But there are in the English language a limited number of words. It is certain that cases will arise in which identical or similar marks will be originated and used independently by different persons. Usually these marks will be used on entirely different articles. But the long arm of coincidence knows no limits; small concerns doing similar local businesses in different parts of the country now and then hit upon the same word or other mark to identify their goods. This is all well enough so long as these businesses stay put in their original limits; but when one or both expand, there is the possibility of their coming in contact.

In practice this actually happens. John Jones, of some Connecticut town, the local apothecary and known to all his constituents by the affectionate diminutive, has a wonderful cure-all descended from his great-grandmother which he dispenses over his prescription counter. At length he puts it up in little packages and builds up a small business in the neighboring counties, having branded the article as Jack's Infallible Nostrum. The business eventually spills over the State line, and finally arrives in the northeastern corner of Ohio. There it strikes a snag.

It appears that some ten years after the mark Jack's was first applied to Mr. Jones medicament, or perhaps ten years before, a Cuyahoga County gentleman by the name of Jackson had invented a very successful cure for the distressing symptoms of the morning after. In recognition of the fact that his acquaintances found two syllables too much of a mouthful in pronouncing his name, he identified this to the local drug trade under the name of Dr. Jack's Miraculous Remedy; and it has had a considerable sale ever since.

It may seem that these are rather trivial and unsatisfactory grounds on which to base the selection of a trade-mark; but a vast majority of the marks in existence have their origin in some equally trivial fact or incident. As the case stands, there is no suggestion and no belief by either party that the other has consciously imitated his mark. Yet one or the other is sure to feel that his rights are invaded. Either the Jones remedy must be barred from Ohio, or the Jackson panacea must be subjected to competition in the established field of its sale by another article of a name similar enough to lead to confusion.

A case recently decided in the Supreme Court was along substantially these lines, the good faith of the two users of the same mark being mutually admitted. The Court laid down the principle that the date of original adoption by either party, and the particular territory in which they now meet, are of no moment. And it then enunciates the eminently sensible doctrine that if either of these "Jacks" had ever wished to protect his mark in interstate commerce, the Federal laws provided him with the opportunity to do so. That neither of them availed himself of this opportunity is evidence that each has been negligent in allowing certain inchoate rights to lapse. So the Connecticut Jack may sell under this mark in the territory where he was first established, and the Ohio Jack may do likewise. Each Jack retains all the rights in his mark which he has previously exercised and no more.

Every small business can profit by the tale thus anonymously and parabolically told. The very first sale in interstate commerce of any marked article can, and should, be made the ocasion of application for a Federal trade-mark. Then if there is any reason why such application cannot be granted this fact will become known in time to prevent the building up of any considerable business under a mark that is open to infringement; and if there is no such reason, permanent trade-mark protection is attained.

# Gas Engine Versus Steam Engine

## The Rôle Which the Motor Truck Can Play in Transportation, as Indicated by California's Experience

By H. A. Crafts

IS the gas engine destined to displace the locomotive? Is the auto-stage to take the place of the passenger coach? Is the auto-truck to supplant the freight car? These are questions that are agitating thinking minds.

These questions are of interest everywhere, but nowhere more so than in California, because California has so long been under the domination of the railroads. Nor is the subject merely speculative. The possible change seems to be on the way. And such inroads are the motor truck lines making upon the revenue of the railroads that the latter are up in arms about it.

One of the important civic institutions of California is the State Railroad Commission. This body has wide plenary power, and does things. It fixes rates to be charged by every common carrier whether it be a railroad or a line of motor trucks. It gives audience to all sides and carefully notes all important evidence. It has power to raise or lower tariffs, as its best judgment may dictate. One of its functions is to grant licenses and franchises for various kinds of transportation lines.

Just the other day the California State Railroad Commission was sitting in the city of Oakland. G. F. Nesson and A. C. Woodward had put in an application for a franchise for a motor truck line to run from Oakland to San Jose, fifty miles south. The railroad folks were there to oppose the granting of this franchise.

The feeling in railroad circles as to the motor truck lines was indicated by the strong language employed by Edward Entelman, assistant superintendent of the Railroad Administration, in his testimony before the board. He referred to the motor truck lines as "robbers of the highway," and charged that they were "not dependable." Then he went on to say:

"Profits that the Southern Pacific Railway Company are making on the line between Oakland and San Jose are very small. On the average the haul from San Jose amounts to only about three carloads per day."

Similar views were expressed by J. L. Allen, traveling agent for the American Railroad Express Company.

In rebuttal of this testimony W. J. Harris, wholesale produce merchant of Oakland, testified that the railroad service between Oakland and southern points was inadequate, particularly in the handling of perishable goods. Slowness of delivery on the part of the railroads was the chief complaint made by Harris. Produce from the South, he said, was not delivered early enough in the day to permit prompt distribution.

"If the produce is not at the store at 5 o'clock in the morning," said Mr. Harris, "the railroad may as well keep it until the next day. As a matter of fact the railroad company seldom makes deliveries before 8 o'clock in the morning." In consequence of this defective delivery on the part of the railroads, Mr. Harris further testified, the commission merchants of Oakland had been compelled to install their own truck lines. But it is not necessary to take the testimony of the railroad people nor of the motor truck men to get an idea of the expansion of the "ship-by-truck" business in California. That which we see every day on the city streets and country highways is sufficient to convince anyone of the revolution that is going on in transportation circles. The motor truck is in evidence everywhere.

From the country districts it is bringing in great loads of milk, butter, eggs, poultry, fruit, vegetables, hay, grain, and other farm products. Often the truck hauls a train of trailers, all heavily laden, yet whirling along the highway at a lively clip. The old-fashioned early milk train on many railroads has become almost obsolete, the big dairies having installed an efficient motor truck service on their own account. The poultry and egg people have followed suit, and with their trucks make four collections and as many deliveries in a day. Outward bound trucks laden with merchandise, household furniture, etc., are in equal evidence. Public motor-truck and auto-stage lines multiply daily and radiate from the larger centers in every direction.

In San Francisco there are 26 regularly organized motor-truck lines that run on regular schedule time. These lines cover routes all the way from five to two hundred miles in length, reaching such points as San Jose, Stockton and Sacramento. Oakland has a motor truck system of almost equal size. The auto-stage lines are also numerous, and their routes extend as far as Los Angeles.

These lines are establishing neat and comfortable passenger stations in the central part of the city. Their time-cards are all worked out to a nicety and occupy prominent places in public view. They appear to be doing a flourishing business, and are most attentive to the needs and comforts of their patrons.

The whole business presents an aspect of extreme democracy. A condition of cordial good fellowship seems to exist between agent and passenger, and between passengers themselves. The latter, in their departures, their arrivals, and their progress along the highway appear more like parties of joy riders than mere wayfarers. These lines make a point of having ample rolling stock and operatives on hand in order that all travel may be handled promptly, and on schedule time.

Both the auto-stage lines and the motor-truck lines appear to bringing the city people and the country people into closer relationship, socially as well as industrially. The two forces are not only revolutionizing established lines of communication, but are developing new fields, remote sections hitherto isolated from the world.

I have it upon the authority of leading automobile experts that there are today in California more than 900 towns and cities containing an aggregate population of 89,000, which are absolutely dependent upon highway transportation. These out-of-the-way places are being brought into closer touch with the centers of popula-

(*Continued on page 210*)

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### Taking the Guess Out of Photography

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 13th last, in the page devoted to "Inventions New and Interesting," I notice under the above heading that a New York press photographer has invented a novel way of focussing hand cameras by means of a telescope, the objective of which is of the same focal length as the lens used in the camera. I am afraid this photographer must content himself with the credit due to a re-inventor, as the device is over thirty years old.

In the "Optics of Photography and Photographic Lenses," by Mr. J. Traill Taylor, published in 1892, a whole chapter is devoted to this very method. The author discusses the question fully, first mentioning a demonstration of the arrangement in 1886, and then dealing with the inadequacy of ground glass screens: aerial images; the nature of the focussing telescope and its adjustment to the camera; the use of the system, and the adjustment of dissimilar lenses to effect any requisite correction of the telescope objective in respect of focal length.

The book could probably be seen in any technical public library, and the chapter in question (No. 29) appears in page 170 of the edition of the work published in London in 1892. Mr. Taylor's name is of course well known as a writer on photographic matters and as a former editor of various photographic papers, including, at some period, the *Photographic Times* of New York. "T. H. P."

Toronto, Ont.

### Who Will Buy Dutch Factories?

To the Editor of the SCIENTIFIC AMERICAN:

At the moment there are for sale in Holland various works, factories and engines, whose present proprietors are without funds to continue their businesses. We are taking the liberty to bring this state of affairs to your attention, and hope that you may be able to give the matter publicity. We should think that American business men might profitably take advantage of the opportunity to buy these items, in view of the fact that the present exchange rates would enable them to buy at very favorable prices. In Germany, too, there would be wide opportunities of this sort, and here the difference in exchange would operate even more in your favor. We should be pleased to handle any inquiries covering this matter.

Arnhem, Netherlands. GEBR. OOSTERHUIS.

### First Naval Electric Drive

To the Editor of the SCIENTIFIC AMERICAN:

May I venture to correct your naval contributor in a statement which appears on page 712 of the June 26th issue just to hand. He states that the U. S. S. "Jupiter" is the first naval vessel of any nation to be fitted with electric drive. If you look up reliable books of reference you will find that the German submarine salvage ship "Vulkan" was the first (1907).

FRANK C. BOWDEN,

London, Eng. Captain, Royal Marines, Retd.

### Further Data on Mexican Oils

To the Editor of the SCIENTIFIC AMERICAN:

Your unexpectedly early publication of my article, "Our Future Oil Supply," forestalled me in certain corrections which have become in order since the original preparation of the manuscript, and which I had intended to ask you to make before you set this matter up. I should appreciate it if you would find space somewhere for them now.

American operations were carried on in the Mexican fields before the date, 1904, which I mentioned; but it was in that year that work was first attempted in earnest.

If I were writing today of the Juan Casiano well, I should have to employ the past tense and speak of its total output rather than its production to date. Just the other day this splendid producer suffered the fate which had already overtaken the Portrero del Llano, being drowned out by salt water.

In speaking of the third field of Mexican oil operations, that of the extreme south, I would like to make the point that in portions of this field, especially in Tabasco, shallow sands are encountered, principally at depths of 400, 800 and 1,200 feet, which are believed to have great possibilities and which have already shown excellent results. Oil seepages here have been known by the Indians for years and the fluid used for medicinal and other purposes.

A. HOOTON BLACKISTON.

### The Life Gun On the Ship

To the Editor of the SCIENTIFIC AMERICAN:

I was very much interested in the letter that appeared in your issue dated June 19th, written by Capt. Edward G. Bancord regarding line-throwing gun, and wish to add a correction and a suggestion.

The Captain quotes the Steamboat Inspection rules as they were. These rules were amended on February 21, 1919, to read:

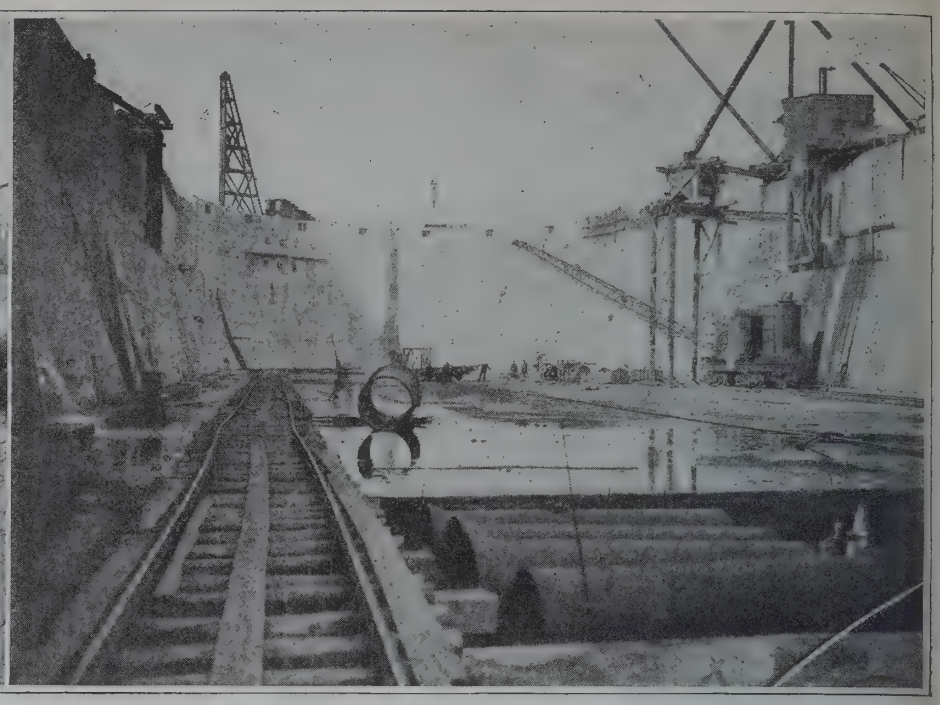
"All steam vessels of 150 ton gross or over navigating the ocean shall be equipped with at least three line-carrying projectiles and means of propelling them, of a type and character which have been officially approved by the Board of Supervising Inspectors."

Being the inventor of the gun illustrated on cover of your issue of January 31, 1919, and having given this particular subject much of my time and attention for the past two years, I feel that I am qualified to speak on the subject, and note that the Captain speaks only of getting a connection between a ship that is stranded and the shore for the purpose of rigging up a breeches buoy. Will he not agree with me (and every seafaring man that I have spoken to on the subject) that its usefulness extends far beyond aiding stranded vessels, especially in getting a hawser to a ship at sea that has broken down and sent out a call for help?

For every case where a vessel goes on to the beach, there are fifty breakdowns at sea in which instance the vessel loses her steering way and is wallowing in most instances in the trough of a heavy sea, making it impossible for the rescue ship to approach too near on either the windward or the leeward side without assuming too great a risk. Right here is where the line-throwing gun can be used to advantage in getting a hawser to (or from) the crippled vessel with which to get her head to sea, or for towing her into port.

New York. MAX RINDSKOPF.

*Left :* General view of the pump well



*Right :* Bottom of the dock, looking toward the head

**Scenes during the construction of the great Philadelphia drydock**

# A Neat Problem in Hydraulics

## How the Delaware River Was Held at Bay During the Construction of the Naval Drydock at Philadelphia

By J. F. Springer

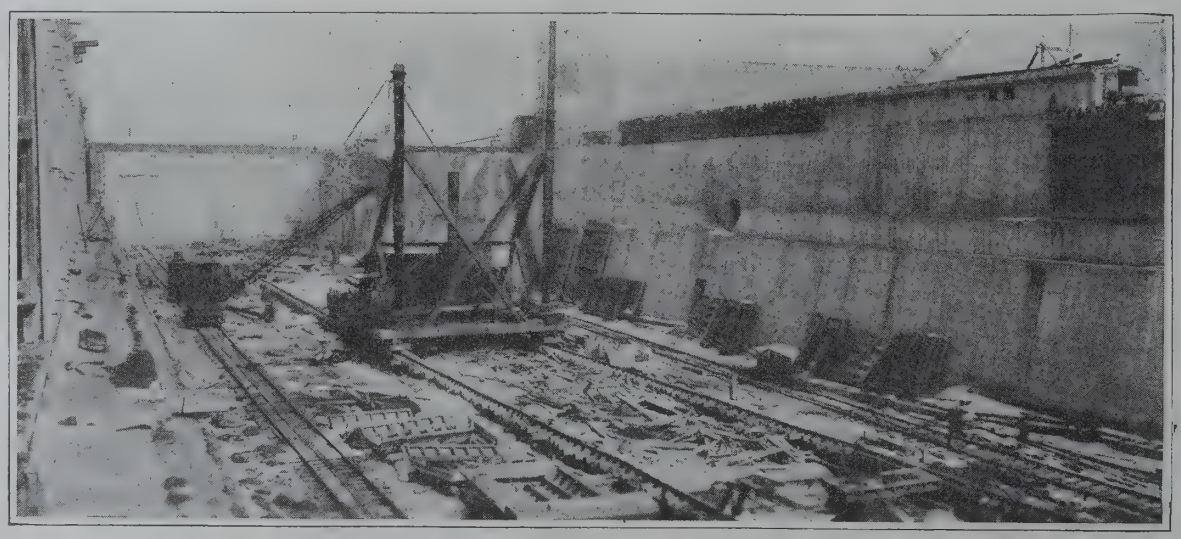
IT is more or less notorious that engineering work involves unknown factors. On a big job it is frequently the case that no one knows what great problem lies ahead. Suddenly, the unforeseen or the unforeseeable happens. The thing that has taken place or the facts that have been discovered may affect the whole general plan and effect a revolution in the method of attack. Men are trying to eliminate uncertainties, trying to ascertain in advance precisely what conditions will have to be encountered at every stop. And a good deal of progress has been made along this line. It is now considered quite the thing to put down exploratory bore-holes over a site where some important work is to be located, the purpose being to find out precisely what the excavation and construction problems are going to be. A good deal of expense is thus incurred; but the money spent is well spent. But, do what he will, nature has so many and so various things at her disposal that she is still able to provide man with surprises.

The big dry dock now under construction for the United States Navy at the Philadelphia yard offers an illustration of the occurrence of the unexpected. A considerable number of bore-holes were put down. These revealed the character, thickness and relative position vertically of the strata covering the site. It was ascertained that a thick stratum of tough red clay covered the site at a level suited to provide a strong impervious footing upon which to construct the floor. The clay was encountered at about 52 feet below the water level. Above it was a comparatively thin stratum of fine hard white sand, which was overlaid by a stratum not much thicker, composed of cemented gravel. Next above was a thick stratum of graded sand. Finally, a great layer of river silt overlay this sand and all the strata beneath. A good deal of this was pretty well known beforehand, so that as these strata appeared during the actual excavation they probably occasioned no surprise. But what was *not* known was the serious results that would ensue upon excavating through the sand and gravel overlying the red clay.

It had been expected to construct a dry dock similar to the new one building at Portsmouth, Va. The side walls of the structure were to be cellular. Pretty much all the excavation was to be done by means of a suction dredge. That is, the dredge was to excavate over the site down to about the desired level, a cofferdam having been put across the entrance to the dock. An earthen cofferdam had been partially constructed and some 460,000 cubic yards of material had been taken out. In fact, the floor of the whole excavation had been pushed down to 27 or 30 feet below low water. What happened then was that, when the dredge operated, the banks would slide in as rapidly as the bottom could be cleared. No side slopes of a reasonable character could be maintained. So the dredge was removed. The cofferdam was now finished and the site unwatered. It was then seen that the cutter of the dredge after penetrating through the river silt had entered strata that were heavily water-bearing. The continued falling in of the banks had resulted from the great flow of water.

After the dredging operations had come to an end, new bore-holes were put down with a view of correcting and confirming the earlier holes. The later holes showed that the stratum of red clay was continuous over the site and that it had an average thickness of about 18 feet. Underneath the clay was found a layer of fine sand well compacted, whose thickness varied somewhat. The finer sand was succeeded by coarser. The holes were continued on down to about 75 or 80 feet below low water, when it was seen that there was enough pressure on the water entering them to cause it to flow freely out of the tubes forming the casing of the holes. The heads of the casing tubes were about the level of the floor of the excavation as left by the dredge. The holes, or some of them, were pushed down 5 feet farther, when the water actually spurted out of the casing heads. The pressure back of these jets was ascertained by means of pressure gages. It was found to be 10.5 pounds per square inch. Now a hydraulic head increases at the rate of 0.434 pounds per square inch per vertical foot. Dividing 10.5 by this number, one gets 24 feet for the effective head acting on the water. The actual head would probably be something greater, as some loss is to be taken into account. The result of the discovery that there was a 10.5-pound pressure on the water was the inference that the Delaware River itself was the source of the water. This meant that the sand under the clay connected pretty directly with the river bottom not far away. In view of this line of reasoning it became important to preserve intact the clay overlying this deep sand. It was necessary to make sure now before proceeding farther, that a sufficient depth of clay would be left over the deepest areas required in the excavation. Furthermore, it was determined to avoid opening up any very large areas at any one time. One vertical foot of clay would balance, by its weight alone, two feet or more of hydraulic head. The under surface of the dock was to be at such levels, however, that at places not a great deal of the clay would be left in place to produce its restraining effect. Nevertheless, by working cautiously at such locations and by putting the concrete in at once the danger could be minimized. This was, accordingly, the general plan.

In order that the excavation might be properly carried down to the full depths required, and these extended to fairly low levels in certain parts of the bottom, steel sheet piling was driven to form a cofferdam all round the bottom excavation. The steel sheeting was driven well into the red clay. The length of the piles varied from 26 to 44 feet, depending upon the depth of the excavation required nearby. The side walls of the steel cofferdam were some 162 feet apart. The wall of sheeting completely enveloped the head end. It was thought desirable, too, to run transverse



**A general view of the finished job, looking northeast**

(*Continued on page 210*)

## How a State May Grow a Timber Supply

By George H. Dacy

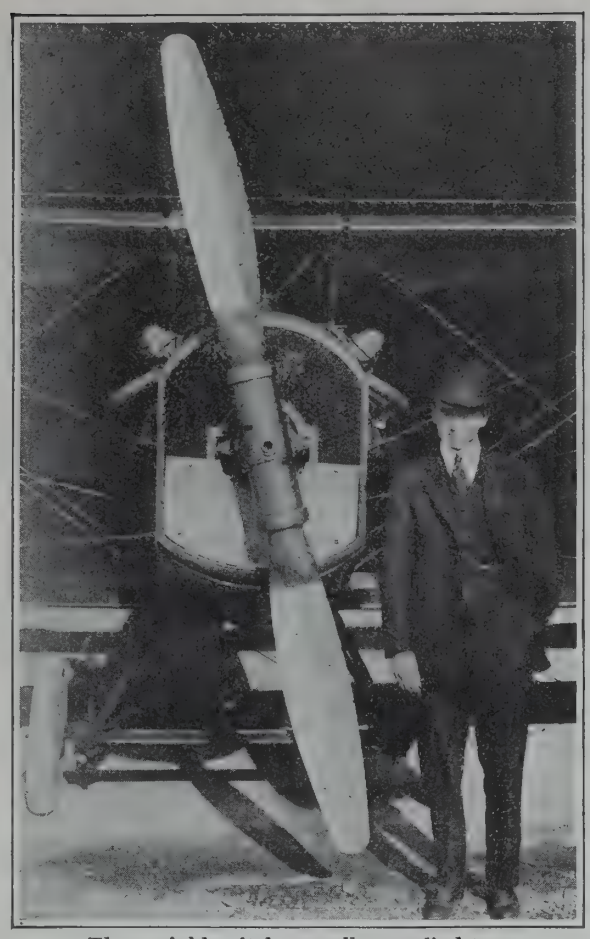
WITH all kinds of lumber in demand at higher prices than ever previously have obtained for building material of this description, the commercial possibilities of planting productive forests for potential utilization are beginning to appeal more attractively to those who, heretofore, have displayed little interest in reforestation projects. The most unique legislation now pending anywhere in the country in this regard is, at present, on the official gridiron at Springfield, Massachusetts. The lumbering resources of Massachusetts are rapidly being exhausted and official statements are to the effect that within the next score of years the State will have to import all the lumber it annually consumes from the Pacific Northwest. Such importations naturally will entail huge expenditures for freightage from the mills where the logs are sawed.

The business, lumbering and industrial interests of Massachusetts got together for a portentous pow-wow over the lumber situation. The result of this meeting was the submittal to the State Legislature of a practical and profitable plan for remedying the potential timber crisis in that State. It was ascertained definitely that there were about 1,000,000 acres of rough and scrub growth land suitable only for reforestation—so far as profitable production was concerned. The bill ultimately drafted proposed that the State purchase 250,000 acres of this land which could be bought for $5 an acre and seed down the entire tract to white pine trees. This work of planting would cost about $15 an acre while the maintenance charges including taxes would aggregate 70 cents an acre annually.

The bill proposes that the State issue and sell bonds to finance the project. It takes about 50 years for pine trees to reach maturity so that the bonds would be issued for that period. At the end of a half century, the value of the land per acre with the interest at four per cent compounded semi-annually would be $368.91. According to expert lumbermen, white pine of this character would yield about 30,000 feet of lumber an acre so that the stumpage value of the lumber at the end of 50 years would be approximately $600 estimating the pine at $20 a thousand feet on the stump, which is a conservative figure.

Thirty-one thousand voters have recently petitioned the Massachusetts State Legislature to pass this bill and at present are working to have a special election called to decide upon the issuance of the bonds. The consensus of opinion is that this project would be a good business venture for the State to embark in while it also would influence to keep the boys on the farms in the regions where the State forests were laid out. Under existent conditions, farm work is slack in the section under discussion during the winter months so that the farm boys have to go to towns and cities to secure jobs. The State forests would alleviate this condition as they would provide plenty of work for men and teams during the winter season when the pressure of farm work was lowest.

A State system of forests such as is outlined in this article would ultimately develop a permanent supplementary lumbering industry which would justify the year-around operations of the sawmills and the construction of small and permanent towns for the lumbermen and their families. And in addition to providing plenty of permanent work for the logging crews it also would occupy the idle labor of the adjacent farms throughout the year in such work as laying roads and trails, thinning the trees, patroling and protecting the forests against fire outbreaks. The permanent establishment of a large scale lumbering industry will develop a home market for all the surplus farm produce which the farmers desire to sell.



The variable pitch propeller applied to a standard airplane

## Varying the Airplane Propeller Pitch

By M. A. Henry

AT last the airplane has been fitted with "three speeds foreward and reverse." Government tests of the Hart variable pitch propeller recently made at McCook Field, Dayton, indicate that this device will accomplish for aircraft exactly what a gear set does for the automobile, greatly improving the efficiency of the machine.

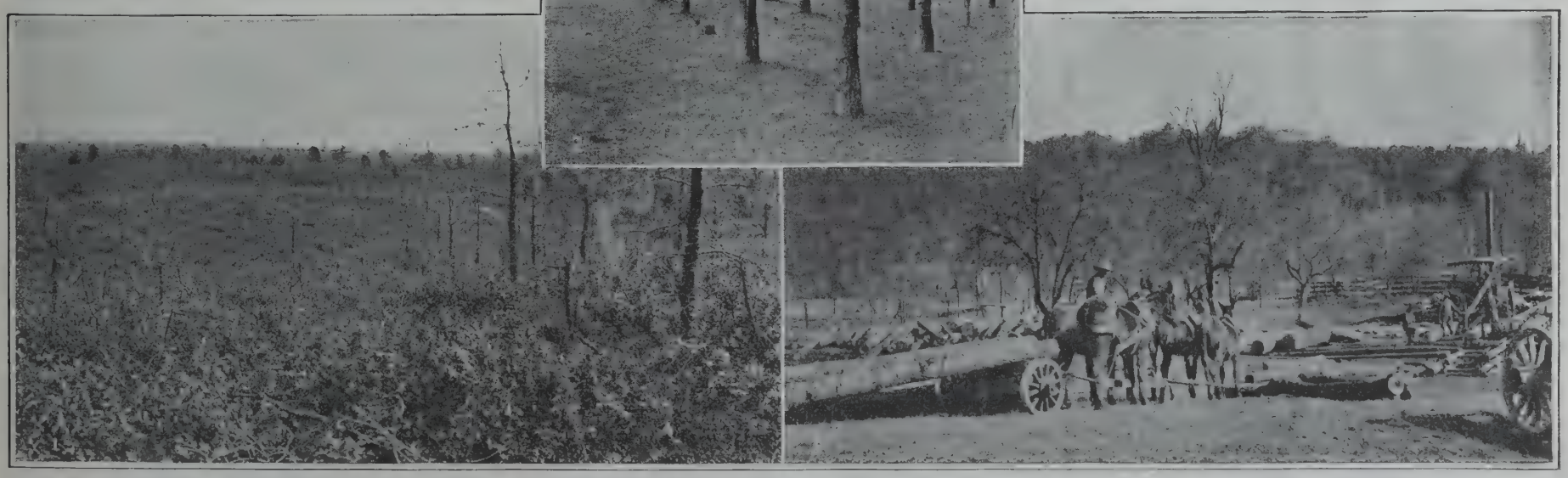
The new propeller permits the pilot to adjust the angle or pitch of the propeller while in flight by the simple movement of a lever. This permits maximum efficiency from both propeller and engine under all conditions, a thing heretofore impossible.

Thus in high altitudes, where the air is thin, the pitch is increased. This prevents the "racing" of propeller and engine. In long cruises, too, the propeller angle is increased and the motor throttled down. This effects a great saving in fuel and saves engine wear. In "taking off" a very narrow angle is used and it has been found that the machine can get off the ground quicker. Equipped with a variable pitch propeller a machine can climb faster and higher. In landing the pitch of the propeller is actually reversed and it becomes a brake, stopping the machine very quickly, once it touches the ground.

While the device was developed for military purposes, it is expected to be a big factor in commercial aviation, since it effects large savings in operating expense. The inventor is Seth Hart of Los Angeles, who brought his invention to McCook Field after some encouraging preliminary tests in the West which were described at the time in these columns. Word comes from France to the effect that excellent results have been obtained with airplanes fitted with variable pitch propellers. It appears that this idea is steadily gaining ground and must soon become a regular feature of aviation.

## Joseph Norman Lockyer, K. C. B.

THE cable announces the death in London, on the 16th inst., of Sir Norman Lockyer, one of the more prominent British astronomers. Sir Norman is a conspicuous instance of the amateur graduating into professionalism, having been in the first instance a clerk in the War Office, devoting his leisure to astronomical pursuits for which an education pursued at British and Continental universities amply qualified him. After a more or less unofficial commission under the auspices of the Duke of Devonshire, he was finally transferred, in 1875, after eighteen years of service at the War Office, to the Science and Art Department at South Kensington. Upon the foundation of the Royal College of Science he became director of the solar physics observatory and professor of astronomical physics. His greatest activity has always been in connection with solar eclipses, eight of the big British expeditions for the observation of these having been conducted by him between 1870 and 1905. In addition he has to his credit successful work in the spectroscopic observation of sunspots and the radial velocities of the gaseous prominences; and for many years he has been one of the leading investigators of the chemistry of the sun. In the latter connection he is the author of several books, both explanatory and speculative. Professor Lockyer passed his eighty-fourth birthday in May, and had naturally, of late years, permitted himself an increasing measure of retirement from active professional duties.



1. Land of this description worth $5.00 an acre and valuable only for lumbering is the kind Massachusetts aspires to purchase. 2. A white pine plantation 22 years old produced on barren sandy land which otherwise would be non-productive. 3. Such a State lumbering project would provide much work for farm labor and teams at periods of slack farm work

**Some pictorial aspects of the Massachusetts scheme for reforesting the barren lands of the Bay State**

# What Has Been Said About Einstein

## A Review of the More Important Popular and Semi-Popular Books and Articles in English

By the Einstein Prize Essay Editor

NUMEROUS prospective competitors for the five-thousand-dollar prize have written us, asking more or less baldly where they may inform themselves upon the subject of the Einstein theories. We have no serious expectations that Mr. Higgins' money is going to be won by anybody whose knowledge of and interest in the doctrines of relativity is of such recent growth that he has to ask this question. Nevertheless, the thing is possible; and since we have no desire to exclude anybody from the competition, the query as to sources is one that must be answered.

At the same time it may be helpful to some of the better informed among the competitors to have their own judgment of the leading discussions supplemented by that of another. And, too, the average intelligent reader—who will look forward to the winning essay and its close rivals to give him an understanding which he has not yet got of the Einstein business—will probably be more than willing to have his way paved toward profitable reading of these essays. So it seems in order from every viewpoint to say a few words here in review of the best of the books and articles which have appeared in English on the subject.

The first book which we shall mention is that of Dr. Eddington. Before reading this we knew that the author was entitled to rank as the leading authority on the subject, probably among English-speaking people and certainly in Great Britain. After we had read it, we knew why. His book bears the imprint of the Cambridge University Press; it bears the title, "Space Time and Gravitation"—just like that. We do not know whether the mark that is missing between the words "Space" and "Time" exists in the author's mind as a comma or a hyphen; either would of course be entirely appropriate. But no doubts regarding the punctuation of the title can cast the least question upon the outstanding merit of the book.

Compared with other volumes upon the subject which have been presented for popular or semi-popular consumption, Dr. Eddington's is fairly large. Compared with some of the strictly mathematical discussions of relativity which have appeared in other languages rather more freely than in English, it is not so imposing. And in fact, on examination it falls on the same middle ground which this casual inspection of its bulk might indicate. It is not for the advanced student of relativity, nor is it for the person who is entirely ignorant of the modern mathematics. Nevertheless, it will be read with appreciation by a very wide and varied audience.

We may, however, without contradiction, qualify this statement to the extent of making it plain that the book will be read in its entirety with complete understanding by few persons indeed. There are parts which assume more than a rudimentary knowledge of differential equations, to which many very competent students of mathematics never attain; and there are parts that call for no mathematical training at all. The larger part of the book lies between these extremes, and will be intelligible to anybody who knows what coordinate systems and equations of transformation are, and who is willing to adopt a few new terms and assimilate a few new ideas as he goes. At the same time there are parts that call for a great deal more facility in handling the concepts of experimental and theoretical physics than either the layman or the mathematician can reasonably be expected to possess; and there are other passages that demand a fluency in the methods of thought peculiar to abstract philosophy greater than we should expect to find in layman, mathematician or physicist. Then there are places where a physicist, a mathematician, or a philosopher would be thoroughly at home in the subject matter, but would probably take exception to the distance which the author has gone in the direction of humanizing his treatment. In a word, the book is written by a man who seems to constitute a rather remarkable combination of mathematician, physicist, philosopher, and plain human being; and only a reader who himself approaches such a combination will get through it without encountering some serious difficulty. The reviewer, for instance, tries to be a mathematician and a human being, but freely admits that as a physicist he scores an absolute zero, and that as a philosopher he is on a level little if any higher than this. But few indeed who possess any inclination to attack the book at all will not be able to read large portions of it with great pleasure and extreme profit.

For the man who has a good general knowledge of what relativity is about and how it operates, this is the book of all books to act as a clarifier of mental processes. We found no alarming quantity of material in it that was absolutely new to us; yet we felt after completing the book that our grasp of the subject had been largely improved. Dr. Eddington has a knack of exposing and illuminating obscure points of whose very existence one had not been explicitly aware; of bringing out with great force the inter-bearings of the various aspects of the subject; of interpreting in terms of the perceptual world about us the abstractions of the mathematical theory. Anybody who believes himself capable in his present condition of writing effectively upon relativity should be able to write more effectively after digesting what Dr. Eddington has to say.

We must not pass from this volume without quoting from the preface a passage which embodies admirably the spirit of the whole book. "By his theory of relativity," we are told, "Albert Einstein has provoked a revolution of thought in physical science. The achievement consists essentially in this: Einstein has succeeded in separating far more completely than hitherto the share of the observer and the share of external nature in the things we see happen. The perception of an object by an observer depends on his own situation and circumstances; for example, distance will make it appear smaller and dimmer. We make allowance for this almost unconsciously in interpreting what we see. But it now appears that the allowance made for the *motion* of the observer has hitherto been too crude—a fact overlooked because in practice all observers share nearly the same motion [when compared to the extreme of possible motion, which turns out to be the 186,000-mile-per-second velocity of light]. Physical space and time are found to be closely bound up with this motion of the observer; and only an amorphous combination of the two is left inherent in the external world [when we have isolated that external world from everything that inheres in the observer]. When space and time are relegated to their proper source—the observer—the world of nature which remains appears strangely unfamiliar; but it is in reality simplified, and the underlying unity of the principal phenomena is now clearly revealed. . . . It is my aim to give an account of this without introducing anything very technical in the way of mathematics, physics, or philosophy. The new view of space and time, so opposed to our habits of thought, must in any case demand unusual mental exercise. The results appear strange; and the incongruity is not without its humorous side. . . ." This is altogether the best passage we have seen anywhere in discussion of the new theories; and the viewpoint here laid down is carried with extreme clarity throughout the book.

If Dr. Eddington's book is the work par excellence for the serious student of relativity in search of an outline for his guidance and inspiration, Dr. Slosson's Easy Lessons in Einstein (New York) occupies almost an equally paramount position with reference to the wants of the person who admits before he starts that he doesn't know anything about the subject and doesn't want to pursue it too deeply. It is the misfortune alike of the relativity theory and of the world that this theory is not easily clothed in terms with which we are familiar. Indeed, it is still an open question whether it is yet possible so to clothe it fully. The above quotation from Dr. Eddington should make it clear why this is so. Einstein shows us that the external world as we have always seen it is an elaborate interweaving of that world as it actually is and as it has been conceived to be through our imperfect observations and the imperfect conclusions to which they have led us. A better example of just what this means and how it works has perhaps not been given than the one set forth by the present writer in an editorial in these columns under date of December 20th last. The ancients, it was here pointed out, in default of any knowledge of how gravity acts in other locations than at the earth's surface, or of the insignificant position which the earth really holds in the cosmic mechanism, or of the true shape of the globe on which we live, must have supposed "up" and "down" to be directions inherent in nature, universally the same. Eventually, with the realization that down was merely the direction toward the center of the body on which the *observer* happened to be located, the concepts "up" and "down" lost any universal significance which they might have been supposed to have; the part which they play in the external world about us was shown to inhere in the observer, rather than in that world itself. It was doubtless with some difficulty that the public at large, in ancient and medieval times, grew into ultimate understanding of this. It is with still more difficulty that we shall come to the parallel but more elusive understanding that the distinction always heretofore made between time and space, and the notion that time runs on forever in a straight line divorced from all dependence upon space, are likewise the contribution of the observer to the world of perception; that the facts inherent in the external world and independent of the observer are quite different.

The very circumstance that all this is so means that when Einstein effects his further separation between the observer's conception and the external fact, what he finds still inherent in the outside world is something new and strange, of which we have no mental picture immediately ready, for which we have no words and even no accurate analogies. This does not trouble the mathematician greatly, because he puts it all into a differential equation, and says that this equation characterizes the space-time which he has just found to be the true one of the external world, whereas a different equation characterizes a space-time of the sort we have had in our minds for the past few thousand years. Strange and incredible as it may seem to the non-mathematician, these differential equations, which on account of the uncouth symbols that appear in them he cannot even read, actually possess meaning to the mathematician and to him seem a sufficient expression and interpretation of what he is talking about. But the layman has got to get a whole new stock of ideas and perhaps even of words in which to clothe these before he can make much of the new doctrine.

Dr. Slosson presents a wealth of material in which such of the old familiar ideas and the old familiar words as come closest to portraying the new concepts are displayed with considerable skill. He exhibits a particularly happy inspiration in pointing out that the doctrines of relativity, in so far as they involve the recognition of a four-dimensional manifold of time and space combined, are not nearly so terrible as the mathematical jargon in which they are couched would make it seem. In a very definite sense, once we realize just what is meant by the term four-dimensional, this manifold is nothing new at all—"unless we are idiots we all think that way" and always have. It is merely the explicit recognition of this, and some of the details that such recognition carries with it, that are

(*Continued on page 212*)

*IN spite of several very candid opinions which have been expressed to the contrary, we cling to the belief that the Einstein competition is going to produce results that will stamp it as distinctly worth while. This, of course, implies that we expect some of the competing essays to surpass in actual subject matter and in the clarity with which this is set forth, anything that has yet appeared of comparable character in English. But this involves a comparison with what has appeared; and equally that this comparison may be made by others as well as by ourselves, and for the several other reasons mentioned in the text, we are moved to present this brief statement of what we have found best in the popular expositions of the Einstein theories. The list of books and articles which we find sufficiently good to mention here by title is indeed deplorably brief, and seems to show the inherent soundness of the donor's belief that there was room for further achievement in this direction.*—THE EDITOR.

## The Airplane in Mine Rescue Work

TO the constantly expanding uses to which the airplane is being adapted—patrolling forest fires, making timber and crop surveys, conveying census blanks in isolated regions, detecting the boll-weevil infested areas in Southern cotton fields, and eliminating distance between the doctor and his patient—is to be added another experimental effort. The assignment of airplanes as rescue workers in mine disasters is the hitherto untried development to be given practical application.

Negotiations are under way between officials of the United States Bureau of Mines and the Aircraft Service of the Army whereby airplanes will be given trial assignments in the mines of Illinois and Indiana. According to preliminary arrangements, in the event of a mine disaster, a plane from the nearest air-service station would be detailed to the headquarters of the district engineer of the Bureau of Mines. Here the air-going machine would be equipped with eight 40-pound oxygen tanks and dispatched promptly to the scene of impending trouble. Geophones, and a rescue car with its trained crew, could likewise be transported by the air route.

The United States officials have pledged co-operation when certain stipulations have been observed by the Bureau of Mines: Provide landing fields, with dimensions of at least 1,800 feet square, at each end of the journey; supply gas and oil at both terminals; and furnish the aviators maps of the route to be traversed. The equipment of desirable landing fields in much of the mining districts seems to be the difficult undertaking—not easy to be complied with in not easily accessible mining regions.—*S. R. Winters.*

## Thicker Aerofoils

A REPORT upon the aerodynamic properties of thick aerofoils suitable for internal bracing deals with the results of a series of tests conducted at the Massachusetts Institute of Technology wind tunnel, with a view to developing aerofoil sections thick enough to permit of internal bracing and the use of cantilever wings without any external bracing of the airplane wing truss. The sections tested were based on the Durand 13, and were varied in section form, in thickness along the span, and in chord along the span. Tapering both in thickness and in chord was found to be highly beneficial to efficiency, and some of the wings developed gave L-D ratios practically as high at angles corresponding to very high speeds of flight as the best of the wing sections for normal type, together with very much higher maximum lift co-efficients. In particular, it was found that the substitution of a thick tapered wing for R. A. F. 6 on a 3600-pound fighting biplane with Liberty engine would increase the maximum speed by 18 miles per hour, due to the saving in parasite resistance by entire elimination of the interplane bracing. A copy of this report may be obtained upon request from the National Advisory Committee for Aeronautics, Washington, D. C.

## Silver Fox Farms in Japan from Canadian Stock

ONE of the strangest and most interesting wild animal shipments left Vancouver, Canada on the steamship "Empress of Asia" the last week in February. The shipment consisted of six silver foxes from one of the largest fox farms in Prince Edward Island, eastern Canada, and was bound for Japan, where a syndicate is about to undertake fur farming. The foxes were valued at $5,000 per head, and were from a long line of domesticated stock, carrying a pedigree as notable as any famous horse or dog. The Japanese spirit of enterprise and their alertness to try any western form of business which promises good returns is most strikingly evidenced in their attempting to raise this producer of expensive fur in their own land. The climate of some parts of Japan, the representative of the syndicate claims, is sufficiently like the natural one of the Canadian foxes as to make the venture feasible. The animals while en route dined on chicken, choice raw beef, lamb and pork.—*By Francis Dickie.*

## British Tidal-Power Plans

IT is understood that a bill will be introduced into Parliament for the purpose of obtaining authority for harnessing a number of Scottish streams, investigations having revealed that the aggregate of available power is larger than had been anticipated.

With respect to the harnessing of the tides, it is reported that "work is about to begin both on the Dee and the Severn, where power can be produced—according to estimates of a group of engineers—at two-thirds the cost of electric power generated by coal. More than this, a number of estuaries on the west coast of England have been surveyed, where the cost of installation would be considerably lower."

The basic principle underlying most of the inventions for harnessing the tides is the working of a turbine by tidal ebb and flow. The tide makes the power at both its inflow and its outflow, only ceasing for a comparatively short time during the period of half tide. In one Cheshire and Lancashire district the great variation in the hour of the tide at neighboring estuaries makes possible, through an ingenious discovery, the production of maximum energy during an almost continuous period.

The plan for harnessing the tides devised by Lewis Woodhead, of Worcestershire, calls for the building of a cheap and efficient wall out in the sea or tidal river, in which turbines are placed. Mr. Woodhead claims that 10-foot turbines would be most economical where suitable, each of which would generate over 300 horsepower with a 5-foot head. Thus a mile of sea wall would be capable of generating 120,000 horse-power. The position of such a wall would be 4 to 6 miles from shore. The greatest difficulty, he stated, that has to be overcome is the possibility of obtaining a space 110 by 30 feet on the sea bed dry, but he claims to have discovered a method of insuring this, so that the wall can be well anchored in the sea bed.

## Glycerine

THE diversified uses to which glycerine is put indicate its importance in commerce. Most of the distilled glycerine finds its way into the manufacture of explosives, such as nitroglycerine, dynamite, and the more recently developed high explosives. These are generally a combination of nitroglycerine with guncotton or nitrocellulose, and the resulting product is known by a great variety of names. Commercially pure glycerine is a well-known reagent in pharmacy and medicine, where nitroglycerine itself is sometimes employed. Glycerine enters into a number of technical processes, such as the manufacture of soaps, inks, water-proof paper, and for the production of such plastic masses as printing rollers and other masses used in the art of reproduction. Glycerine is also used in gas meters and tubes which must withstand great cold, and for filling hydraulic jacks. It is one of the important items in sizing textiles and in that treatment of wine, beer, and vinegar known as "scheelizing."

## Disinfecting Barrels and Casks with Ultra-Violet Light

ULTRA-violet rays have long been employed for sterilizing drinking water, milk, and other liquids, but a new application of them in Germany reported in *Chemische Apparatur* (Leipzig) is for the disinfection of barrels and casks, particularly beer casks. For this purpose quartz lamps are lowered into the cask to be sterilized and the light turned on for fifteen to thirty seconds. It has been found inadvisable to continue the illumination for a longer time in ordinary casks coated with pitch, since the resultant rise of temperature causes the formation of fumes of pitch. The lamps vary in size according to the dimensions of the casks. In small and average size casks the time mentioned is sufficient to secure complete sterility. Some difficulty is met with in using this method for very large pitch-coated barrels, even when there is a corresponding increase of size in the quartz lamp and a suitable tension, for the reason that so long an illumination is required that the aforesaid fumes are produced. The method is not to be advised therefore except for barrels which are not coated with pitch.

## An Apple-Shipper's Makeshift

SHORTAGE of refrigerator cars has stimulated apple shippers of the Northwest to interesting makeshifts. In one recent season, a considerable portion of the British Columbia apple crop went to market in box cars equipped with stoves and stove-pipes. The shippers supplied men to care for the apples in transit, keeping the cars heated, and the apples arrived at destination in good condition.

A Chelan Falls, Wash., fruit shipper was confronted with a somewhat different problem this spring when he had 26,000 boxes of apples to market, and couldn't obtain refrigerator cars. He could not tell what kind of weather the apples would encounter en route to Cleveland, Ohio, where he planned to market them, but average seasonal weather would involve danger from heat rather than from cold, and he made his plans on that basis.

He obtained box cars and had a false floor placed in each. Beneath this false floor was sawdust, soaked with water to provide the apples with moisture. He accompanied the train of 28 cars, and saw to it that each night the car doors were opened to allow the apples to cool off.

Happily, no unfavorable vicissitudes of weather were met with. In Montana, the temperature got down around 25 degrees and froze the water in the sawdust. This tended to keep the apples cool throughout the remainder of the trip.

The train went through to Cleveland in nine days, much less than the usual running time. When the apples were unpacked, they were found in excellent condition. On the average, for the season, the makeshift was well calculated to be successful, but the shipper admits that a bad cold wave would have been serious. He had to take a risk somewhere.

## The New Floral Clock

SINCE Linnaeus worked out his floral clock the list of available subjects has been very much increased. This is due to the introduction of fresh kinds of plants and also owing to the fact that new varieties of the old ones frequently show a variation in the time of opening their blooms.

The chief difficulty in putting together the list of subjects for the floral clock has been that they must all flower at the same time of the year, preferably in the summer months of June and July. Also the twelve species selected must expand their blossoms in successive hours from six in the morning to five in the evening. After a large amount of experimenting the following selection of plants has been put together and this is claimed to be the most perfect list for the floral clock up to date. Slight variations in the times of opening might occur in different localities, but it is remarkable how closely the various plants adhere to the times of opening. The times of the expanding of the buds are in all cases put before the name of the plant: 6 a.m., Yellow Hawkweed (Hieracium aurantiaca); 7 a.m., Marigold (Calendula pluvialis); 8 a.m., Venus' Looking Glass (Specularia speculum); 9 a.m., Corn Marigold (Calendula arvensis); 10 a.m. Clovewort; 11 a.m., Mountain Dandelion (Taraxacum montanum); 12 a.m., Fig Marigold (Mesembryanthemum); 1 p.m., Single Pinks (Dianthus); 2 p.m., Pyrethrum corymbosum; 3 p.m., Red Hawkweed; 4 p.m., Lady of the Night (Mirabilis dichotoma); 5 p.m., Catchfly (Silene noctiflora).—By *S. Leonard Bartin.*

## Air Conditioning

IT is only lately that the proper conditioning of air has been recognized as a subject of fundamental importance in many industries. The possibilities of overcoming unhealthful air conditions are of course extensive and a secondary consideration is the aid to manufacturing processes which satisfactory atmospheric conditions give.

In the production of gelatine products, low temperatures and constant low moisture conditions must be maintained. In confectionery establishments cool, dry air becomes a requirement. In the baking industry a high humidity with proper temperature maintained constant, eliminates important variables in the raising of dough and enables the baker to standardize time. In the photographic industry the proper conditioning of air has been practised for some time, for otherwise there would be many days too hot or too damp for the production of satisfactory material. Even the printing art requires the conditioning of air, where several colors are used in the production of illustrations, for the perfect registration necessary for success cannot be expected under greatly varying atmospheric conditions. The silk industry has practised conditioning for a long time, but we have not yet been able to extend this work into the wool and cotton field. In modern textile mills, however, apparatus is being installed by means of which the condition of the air can be satisfactorily controlled.

## A New Cyanide

THE development of a process for obtaining cyanide from cyanamid was recently reported before the New York Section of the American Electrochemical Society. It marks another accomplishment in the field of American electro-chemistry. The work has progressed rapidly, and the statement is made that in a few months more was accomplished than had been achieved abroad in fifteen years. Three months after starting designs for the plant, four tons of equivalent sodium cyanide were being produced each day, the grade being unusually high. Within a year a single small electric furnace of the continuous type was producing a very satisfactory cyanide at an unusually high efficiency.

The product is said to be uniform in quality, to possess desirable physical characteristics, and to be competing with the pure high-grade cyanides for markets where the latter has long been intrenched. The material is adapted for case-hardening, may be employed in the electro-plating industry, in connection with precious metals, and the preparation of pigments and prussic acid.

# Fire Without Firemen

## How the Coal Is Fed Mechanically to the Huge Grates Beneath the Modern Boiler

By H. A. Mount

WE are all worshippers of the colossal. The biggest steamship, the tallest building, the longest bridge never fail to interest. And in our admiration of big things we ofttimes forget the little things which make them possible.

Imagine, for instance, ye who have fumed over the family furnace on a cold day trying to fire by hand, one of the great modern steam boilers, with a fire grate 27 feet wide, that consumes more than six tons of coal every hour!

We hear very little of the mechanical stoker and yet it is one of the biggest "little" things of modern industry. Without it our whole scheme of power generation would have to be revised. The mechanical stoker was originated, not so long ago, to replace the grimy workman, whose sweat-gleaming torso, lighted by the furnace glare as he heaved shovelful after shovelful of coal, furnished one of the oftenest-pictured features of industry. But today the mechanical stoker finds a much wider usefulness.

Boilers which a few years ago were hand-fired are machine-stoked today with an increased efficiency of from 25 to 50 per cent. The amount of power used in this country has been increasing in recent years at a terrific rate. The mechanical stoker has made it possible to meet this increase, not by multiplying the number of boiler units, but by increasing their size.

The capacity of a boiler obviously depends directly on the amount of coal that can be burned under it. This in turn is governed by two factors; the area of the grates and the amount of coal which can be burned per hour on each square foot of grate surface. Mechanical stokers make possible the use of huge grates which would be impossible to fire by hand, and at the same time allow the coal to be burned with maximum efficiency.

Undoubtedly, had the mechanical stoker not been invented, we would have seen fuel oil and gas used to a much greater extent than at present. The stoker gives the same even, continuous fire with a low grade of coal, as can be had with either of these fuels, which cost approximately three times as much to burn.

There are available a number of types of automatic stokers, each of which has its sponsors. Two of these will be described here and they are representative, in a general way, of the whole field.

The simplest of these, and the type most generally used, consists of a fuel magazine or retort inside the furnace, to which leads a conveyor pipe. In the conveyor pipe is a screw or worm conveyor which constantly pushes a supply of fuel into the bottom of the pot. The fuel is ignited on top and the fire bed is formed on the upper edge of this magazine. The rising fuel from below causes the fire to overflow from the retort to sloping grates on each side.

As the coal moves upward through the fire-box and approaches the fire it is slowly roasted and coked. The released gases, mingled with a controlled supply of fresh air, ignite and burn as they pass through the blazing bed of coke above. The coal is delivered to the grates as coke and the continuous feeding gives a breathing motion to the coke bed, keeping it open and free for the circulation of draft. The coal is fed into a hopper on the outside of the furnace, either by hand or by machinery.

One of the prime essentials of the device is a method of producing a forced draught through the fuel bed, which can be closely controlled. The air is furnished by a blower or fan, operated by steam from the boiler or by electricity. The air is conducted to a wind box located beneath the retort and is distributed through tuyeres communicating with it. The distribution of air is regulated by a wind gate at the mouth of the wind chamber. The tuyeres are the only parts subject to destruction by heat and these are detachable so they can be quickly and cheaply replaced.

Due to complete combustion through the coking process, low grade coal can be used. The fact that it is seldom necessary to open the fire doors while the stoker is in operation effects another saving, estimated in some plants as high as 20 per cent. Ordinarily the fire doors may be kept closed for periods from six to eight hours. The largest saving, however, is due to the air control.

When it is considered that about fifteen pounds of air are required to burn one pound of coal, and that of this four-fifths is inert nitrogen which must be raised to furnace temperature but which does no work, the importance of using only the precise amount of air needed is realized.

The stoker forces the coal upward and into the fire and over the tuyeres. The tuyeres discharge the air into the coal at the points where the gases are liberated during the coking process. The gases ignite and pass off through the incandescent coal bed without smoke. The air is introduced under pressure to enable it to penetrate the coal bed where it is thickest, where it requires the most air and where there is the most resistence to a natural draft.

The forced draft equipment is a very important part of an underfeed stoker. A sufficient volume of air must be forced through the fires to burn the maximum amount of coal intended, and this naturally depends on the size and design of the ducts and the amount and kind of coal which it is proposed to burn.

A variation of the type of stoker just described injects the coal into the retort by a reciprocating plunger, which is actuated by a steam-driven piston in front of the boiler. The plunger has mounted on it several pushers which carry the fuel along with them on a forward movement, but slide through the coal in the reverse direction. This type of stoker also is usually equipped with grates with moving fire bars. As the coal rises in the retort it is distributed to the sides of the grate by the moving bars. Every other bar in the grate is made movable by mounting one end on a rocker rod, which is actuated by the same piston which moves the fuel injector. In very large boilers as many as three of these units may be mounted side by side. The ash is drawn off from trays between and at the sides of the units.

Automatic control may be provided for these stokers so that the only duty of the fireman is to dump the ash trays occasionally.

The second type of stoker is radically different in construction from those just described. In it, the fire grates take the form of a slow-moving endless belt, on which the coal is carried through the combustion chamber, being gradually consumed as it moves, and being dumped as ashes at the rear. This type of stoker is particularly adapted to very large boilers which have to meet sudden overloads, as those in large powerhouses.

Forced draft is also provided here and by varying the volume of air drawn through the fire the speed of combustion can be closely controlled. By raising or lowering a gate under which the coal passes from a hopper on entering the combustion chamber the amount of coal can be quickly regulated. The draft and amount of coal must be so regulated that the coal is completely burned and only ash and not live coals is dumped at the rear. The grates may be driven by steam motors or turbines, using power from the boiler, or by electric motors.

The grates are made porous to allow the passage of air from beneath. One advantage of this type of stoker is that all of the burned material is dumped at each revolution of the grates and there is no trouble from clinkers or obstruction of the fire by ashes.

Not only have automatic stokers replaced hand firing in nearly every important power house, but they are very important equipment in some of our big industries. They are used for instance in many annealing furnaces and in the big forges where steel ignots weighing tons are heated. It is desirable in

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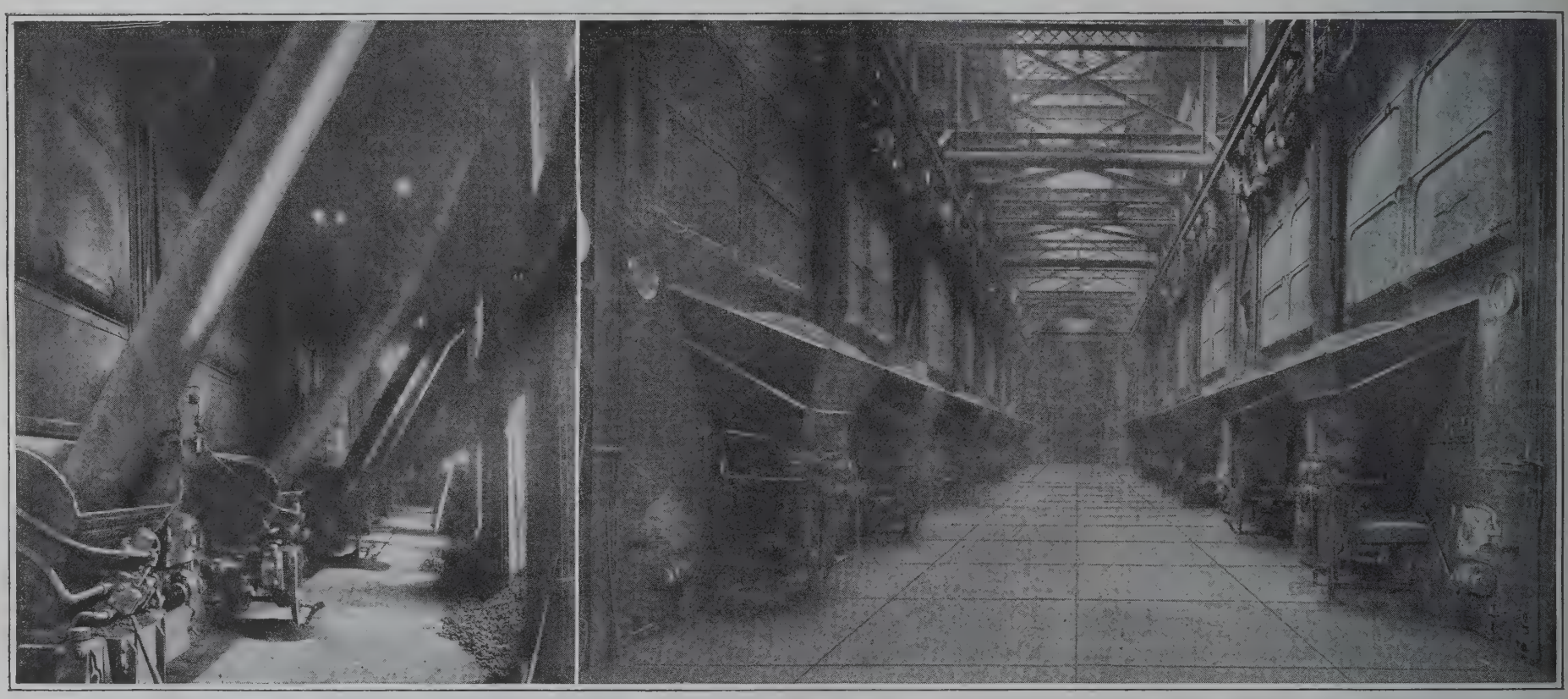

**Typical automatic stoker installations, showing the simplicity and neatness of the automatic system over the usual manually-fired equipment**

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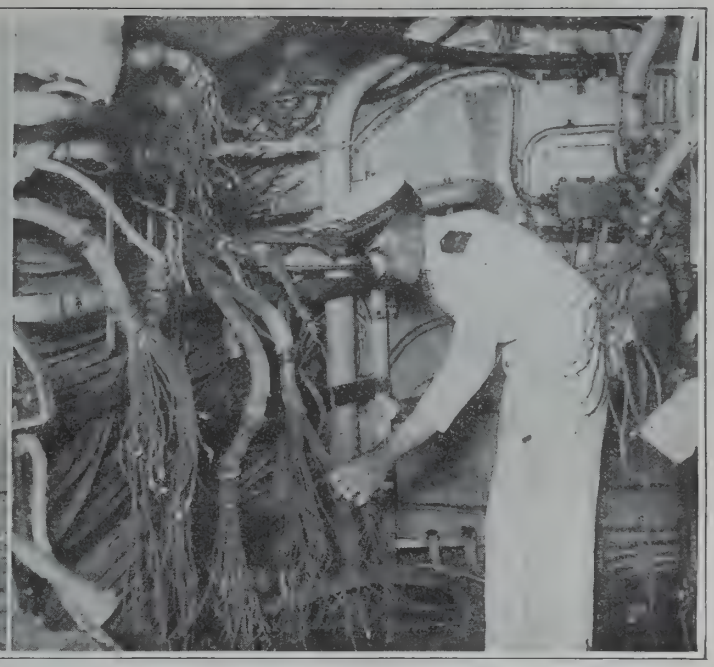
**The surrendered German dreadnought "Ostfriesland" as she steamed into New York harbor. She will first be carefully studied and then shot up in target practice**



**This shows how the Germans wrecked the electrical wiring—the nerve system of the ship**

## The Surrendered German Battleship

IF anyone asks why the surrendered German warships have little or no value for the United States Navy, one suggestive answer can be found in the characteristic picture which we publish, showing the destruction wrought by German hands on these ships before they were surrendered. What they did to the electric wiring (which may be called the "nerve system" of a battleship) was matched by other destructive work to the fire-control mechanism, gun telescopes, range finders, compasses and a hundred other of the important details of battleship equipment.

The "Ostfriesland" formed one of the second group of dreadnoughts built for the German navy. Her sister ships were the "Thuringen," "Helgoland" and "Oldenburg" In designing them, the Germans repeated the tactical mistake which they made in the previous, or Westfalen, class; for they placed the six two-gun turrets in such a way that at no time, and on no line of bearing, can more than eight out of her twelve twelve-inch guns be brought to bear upon the enemy. These ships were laid down in 1908 to 1909, and it was not until five or six years later, when the Germans built the "König" class, that they placed all of the turrets on the central line of the ship—a practice which we have followed in our navy since 1906, when we laid down our first dreadnoughts, the "South Carolina" and "Michigan."

The "Ostfriesland" is a ship of about 23,000 tons displacement, with an eleven and three-quarter-inch main belt, reducing to six inches at the bow and four inches aft. The turrets are protected with eleven and twelve inches of armor, and the six-inch battery, which musters fourteen guns, has six and a quarter inches of protection. The ship has the great beam of 93¼ feet—this in order to allow for wide anti-torpedo spaces between the outside of the hull and the vitals of the ship. She is a triple-screw ship designed to be driven at twenty knots with 25,000 horse-power. Like all German battleships which were designed merely for the North Seas, her steaming radius is so limited that she would be useless for the world-wide activities demanded of ships of our own and the British navy.

## Oil as a Locomotive Fuel

**By Charles N. Winter**

OF the many readjustments necessary to meet the changed conditions throughout the entire world, none is more important than the subject of fuel for locomotives, particularly in places remote from the sources of coal—the most commonly used fuel. The greatly increased cost of mining coal and transporting it long distances has raised the price to a point making its use as a locomotive fuel prohibitive in many parts of the world. This has a direct and far-reaching effect on the ultimate cost to the consumer of every necessity of life, hence concerns not only those who own and operate the railroads, but every person in every station of life.

Many experiments have been resorted to—burning of wood, maize, etc., but for general utility and economy oil has proved to be the most satisfactory substitute for coal as a locomotive fuel, and its use is increasing.

The coal shortage in Argentina led to a great increase in the use of wood, but due to its great bulk and the increasing difficulty of replenishing the supply, the hauling of wood became a great volume of the railroad traffic and threatened to become a monumental task. It soon was realized that more suitable fuel must be procured. Illustrative of the extremities resorted to in Argentina is the reported burning of maize as locomotive fuel. The fuel problem in that country has been partially met by equipping locomotives with oil-burning appliances and agents are now in the United States investigating the most economical methods of using oil fuel.

Pulverized coal is being burned successfully and experiments are being made with colloidal fuel—a mixture of pulverized coal and oil—but these methods require a somewhat complex apparatus and they cannot, as yet, be said to be generally applicable.

Another method being given consideration by some combustion engineers is the generation on the locomotive tender of producer gas which would permit the utilization of inferior grades of fuel now useless as locomotive fuel.

Oil-burning locomotives are by no means new, having been used in some parts of the United States and in other parts of the world for many years, but where coal has been available it has generally been used.

It will be interesting to those not directly concerned in railroad operation to learn of some of the means employed to burn oil as locomotive fuel. There are many different means employed to feed the oil into the locomotive firebox, but the general construction of such apparatus is substantially constant. Briefly the cycle of operation is as follows: The oil is fed by gravity from the oil tank, on the tender, through the oil heater and piping, to the burner, where it is vaporized and blown by a steam jet or a steam-and-air jet into the firebox and ignited by a piece of burning waste thrown in through the firedoor.

Two most important parts of oil-burning apparatus are the oil heater and the oil burner. One heater consists of a cylindrical chamber through which the oil flows on its way to the burner, and is heated by steam passing through the pipes contained in the cylinder. Another type reverses this procedure, the chamber containing the steam and the oil passing through the pipes. Still another type consists of two concentric tubes enclosed in a cylinder, the oil flowing between the surfaces of the inner and outer tubes and being heated by steam, which occupies the space inside of the inner tube and outside of the outer tube.

The use of the heater is resorted to in order to reduce the viscosity of the oil and at the same time to raise its temperature to a point just below vaporization before blowing it into the firebox.

Numerous designs of oil burners have been used successfully, but they may be grouped into two general classes; those in which the oil and steam, or steam and air, mix and vaporize the oil inside of the burner; and those burners with which the mixing and vaporization takes place outside. Some burners of the outside-vaporizing type have a projecting corrugated lip which assists in atomizing the oil as the steam impinges on the corrugations. Usually in the inside-mixing type, the oil flows through the top chamber and meets a jet of steam and air which vaporizes the oil just inside of the outlet to the firebox.

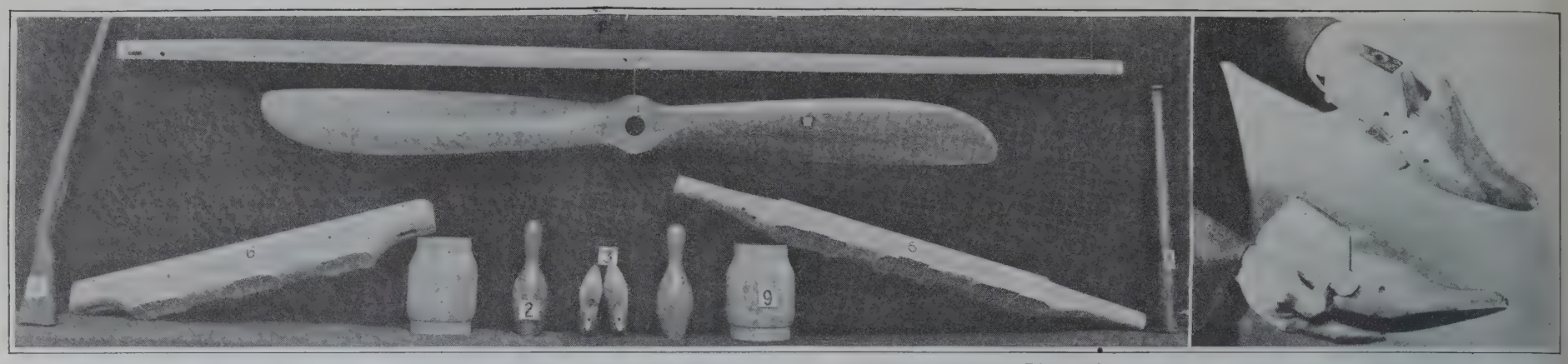
The conversion of locomotives from coal burning to oil burning is comparatively simple and inexpensive. The oil tank can be installed in the coal space of almost any locomotive tender and the oil-burning apparatus installed in the locomotive itself with very little alteration to the firebox. This is already being done on certain divisions of a number of railroads in the United States. The Seaboard Air Line recently installed oil burners on all locomotives on a southern division of the road and has contracted for an immense supply of oil for a long period. The Santa Fe System, the Southern Pacific and other railroads of our Southwest have many oil-burning locomotives and are planning an increase in such equipment.

For months past the railways of France and Spain and other European countries have had engineers in America gathering data on the subject of oil as a locomotive fuel and the equipment of a great part of their locomotives with oil-burning apparatus is begun.

Fuel oil is found in many parts of the United States, in Mexico, in Argentina and other parts of South America, in Rumania, Russia and elsewhere, and as it may be handled with much greater facility than coal it is destined to come into more extended use as a fuel.

A conservative estimate of the relative heating value of oil is that three and one-half barrels of oil are equal to one ton of coal, which, at the prices of the two fuels, would effect a saving of from 20 to 40 per cent in fuel cost, to say nothing of the lower cost of handling oil as well as other operating economies. Thus, the ease with which the fireman can manipulate the oil-burning controls makes it possible to secure a very high degree of economy in the use of oil.

**An American oil-burner having a tractive power of 40,000 pounds. Total weight of locomotive, 440,000 pounds; oil capacity, 2,900 gallons; steam pressure, 200 pounds**



1. Aircraft propeller. 2. Bowling pins. 3. Shoe lasts. 4. Wagon pole. 5. Wagon axle. 6. Wagon bolster. 7. Rifle stock. 8. Baseball bat. 9. Wagon-wheel hubs. Separate views at the right show laminated shoe lasts

**Typical articles of built-up plywood from the Forest Products Laboratory**

# Wood That Is Stronger Than Steel

## How Thin Veneers and Water-Proof Glue Have Conspired to Build a New Industry

By Robert H. Moulton

THE weakness of wood is in its grain—the fact it is made up of a bundle of fibers. Each of these by itself will stand a considerable pull, but each fiber in the bundle is held loosely to its neighbors on all sides. To make a wood that is capable of standing strain in all directions, it is necessary to combine several layers cut at various angles to the grain. Thus is made "plywood," said to be literally "stronger than steel." It is revolutionizing airplane construction, and it will enter conspicuously into postwar industry. It is even possible that as a wall-covering the thinner varieties will compete with wallpaper; they possess all the beauty and durability of heavy wood paneling, for their composite nature prevents them from warping. Thin plywood has been found, in toughness and flexibility, to compete favorably with textile fabrics in the manufacture of airplane wings.

If anyone should say offhand that, weight for weight, wood was stronger than steel, he would be laughed at. However, the Forest Products Laboratory at Madison, Wis., which is responsible for our knowledge of plywood and the various uses to which it may be put, has devised a testing machine which proves this very thing; only, of course, the strength of the wood is estimated by the pull it will stand running with and not against the grain. For example, a toothpick of pine wood placed in this machine and weights applied, with the idea of pulling the toothpick apart in the middle, will usually stand a pressure of from 75 to 100 pounds before it gives way. As against this, a 3-inch length of steel wire, of the same *weight* (not the same daimeter) as the toothpick, generally gives way when the tension reaches about 30 pounds. Various tests with this machine have shown that all of the denser woods can beat steel by from three hundred to six hundred per cent. When tested across the grain, however, the best of wood shows only from one-fourth to one-half the strength of steel. That's why plywood was invented.

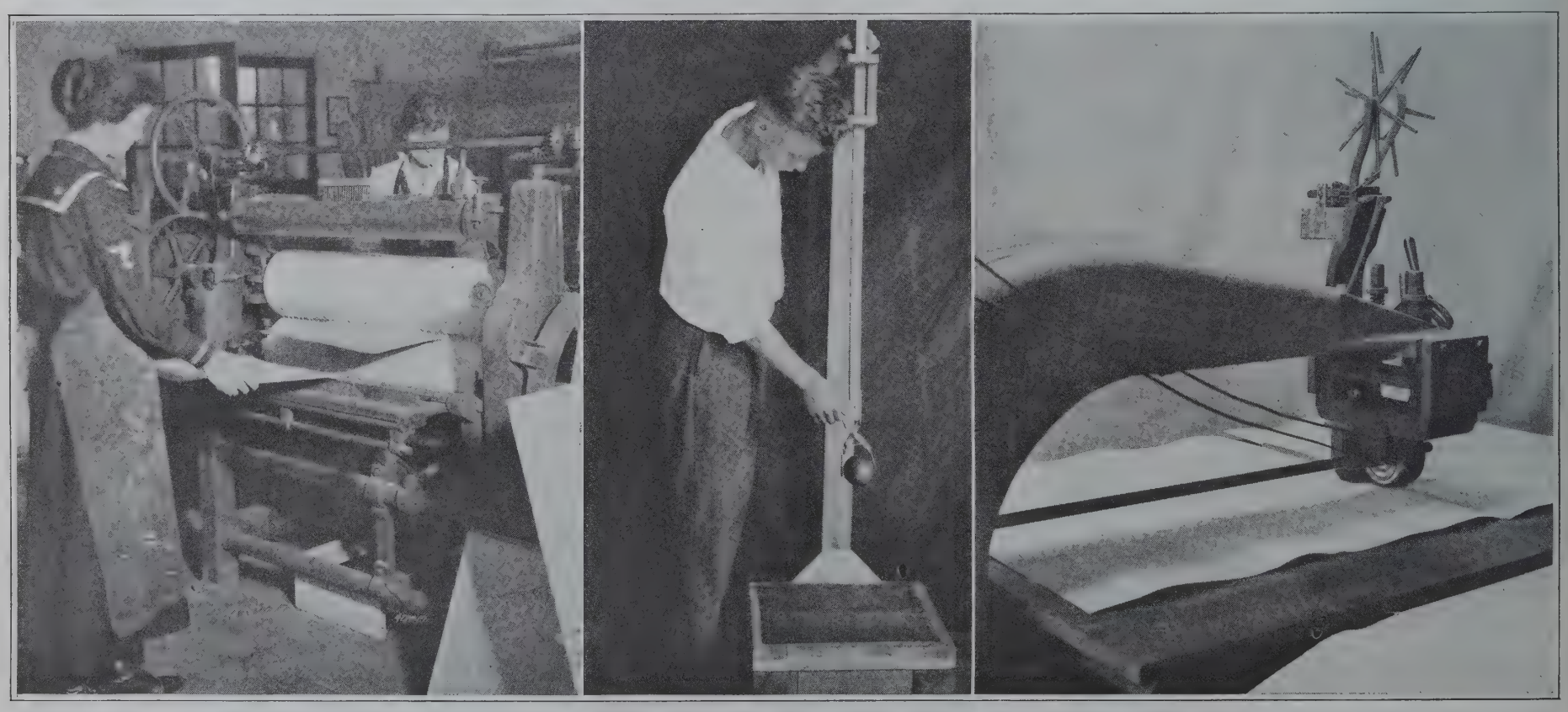
The panels used in the manufacture of plywood vary in thickness according to the article to be made of it. In the case of material for airplane wings, for example, they are only .01 inch in thickness. Gluing thin veneer into a very thin panel of plywood has always been an extremely difficult matter for the manufacturer. The principal cause of trouble has been the excessive swelling and shrinking of the thin plies due to their absorption of water from the wet glue, which causes overlaps and a considerable amount of wrinkling. A second source of trouble is in the handling of the very thin material when it has been coated with a wet glue, since it is very fragile and easily ruined when handled wet.

To overcome these difficulties the Forest Products Laboratory has evolved a process which consists of making a sheet of glue by coating thin sheets of tissue paper with blood glue, allowing it to dry, and using the coated paper as the glue layer for plywood. The process of making the panel then consists merely in laying alternately as many sheets of thin veneer and sheets of this glue tissue as may be required to build up the panel desired. These sheets are then pressed in a steam-heated press which activates the glue. The result is an extremely thin panel in which the moisture content has been changed not more than one or two per cent. This simple method eliminates the troubles resulting from the use of a wet glue, and makes the handling of the thin material an easy matter.

The extremely thin plywood secured in this manner and tested on airplane wings built especially for the purpose proved surprisingly strong. It was found that it gave between six and eight per cent added lifting power over the linen ordinarily used, by reason of the fact that the "flap" of the cloth is entirely eliminated. Weight for weight, its strength proved to be approximately the same, and it is quite likely that in the future all wings may be covered with this material.

When plywood was first thought of in connection with airplanes, an apparently insurmountable difficulty presented itself. A machine that had to be out in all kinds of weather and spend much of its time in a dense fog and in thick clouds—often approaching 100 per cent humidity for long periods—must not be held together in any way by glue that water would dissolve. To overcome this difficulty two new glues were evolved

(*Continued on page 212*)



*Left:* Spreading casein glue on veneer sheets, the glue being applied cold. *Center:* The toughness test on thin plywood, in which the height is observed from which a steel ball must be dropped to splinter the sheet of veneer as it lies stretched over a hollow frame. *Right:* Machine that applies tape to the bundle of veneers, to hold the strips together prior to the application of the glue

**The manufacture and testing of plywood at Madison**

**Fifteen stumps a day without dynamite**

## The Tripod Stump-Puller

THE direct application of the power to uproot the stump vertically instead of at an angle, so that the useful component of the force exerted is practically that entire force instead of half or less thereof, and the virtual absence of a hole to be filled where the growth is displaced, are among the virtues claimed for a tripod stump puller which we illustrate herewith. The machine is powerful and is capable of lifting huge stumps without the assistance of dynamite, although the use of the latter is a valuable ally in cracking the securely intrenched tree growth.

The tripod pullers, with respect to types, are threefold in number, screw, windlass, and lever machines, the last-named being more widely used. No anchor stump is necessary in using the lever pattern, the puller being set immediately over the stump and the machine is moved for each succeeding performance. The stump is displaced by chains encircling one of the larger roots.

The tripod stump puller has proven its efficiency in uprooting huge white and Norway pine stumps growing in the sandy soil of Michigan, and has a limited use in the Mountain and Pacific Coast States as well as the South. Four men and an equal number of horses constitute an efficient working unit, the Office of Farm Management, U. S. Department of Agriculture, having assembled data indicating that on five tracts of land crews averaged 79 stumps a day for over 140 days. The tripod machines cost from $125 to $200.—By *S. R. Winters.*

## A Big Lifting Barge

THE accompanying picture shows the largest derrick barge on the Pacific doing a rather novel stunt—lifting a building tower at the shipyards, and moving the tower a distance of about one block. The tower weighs about 65 tons, is 65 feet in height, and carries two derricks on its deck, one of these being 100 feet in height.

A number of cables were connected to various parts of the building tower and the derrick barge walked off with it easily. Had it not been for this barge it would have been necessary to take the tower apart, which would have required much time and entailed quite an expense.

The new barge recently performed another novel job. It lifted a 150-ton deckhouse from topside of a steamer and with great ease deposited it on a nearby wharf. The task under the old system would have consumed several days and the labor of a gang of men. The work was done by cutting the deckhouse in half and transporting each 75-ton half.

A short time ago the derrick barge succeeded in pulling a new steel tanker from the mud after a number of powerful tugs had worked three days and failed. The owners were preparing to dredge around the tanker, which was on the mud a distance of about 50 feet. The top lift line and the heavy load line of the barge were connected to the tanker and she was pulled back into the water in half an hour.

The steel derrick, it is estimated, will be able to lift the stern of a big vessel well out of the water so as to enable the workmen to replace a propeller, and the vessel would not have to go into dry dock. Above the wooden hull towers a triangular girder frame of steel 85 feet high. The boom is a lattice girder of steel 100 feet long and is designed to take 100 tons at a 50-foot radius and an 18-ton weight on its maximum working radius. Complete electric outfit is provided and a large air-compressor for working drills and other tools, or for supplying air to pontoons, or for forcing water out of wrecked hulls. Living accommodations are provided for a large crew of men and the barge carries sufficient fuel and fresh water to remain outside on a wrecking job for several weeks at a time. A feature of this barge is the hydraulic weighing machine. This device records the object lifted to the minimum of a pound.—By *C. W. Geiger.*

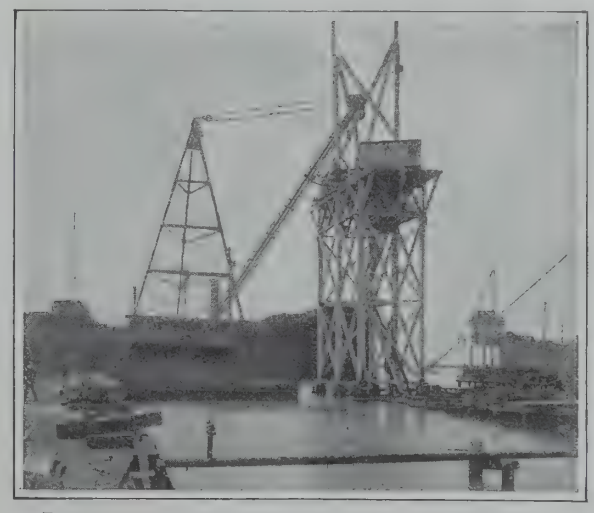
## Barrel Rigged to Haul Water

OFTEN the farmer needs to carry water about the premises in larger quantities than could be carried in a bucket by hand. Even if a water system is employed he does not care to install an extra conduit to such places as the temporary hog watering trough, the concrete mixing vat, the garden to water crops during an extended drouth, etc. The photograph herewith shows how one farmer rigged a 50-gallon kerosene barrel to be easily carried full of water by rolling it on the ground to any desired place on his farm Description of how this outfit is put together is superfluous.

The barrel is filled by removing the bung plug or stopper and then replacing it till arriving where the water is desired when it can be removed to draw out the water; the man whose outfit we illustrate has a faucet screwed into a hole bored in one of the heads to draw the water as needed, taking it out and putting in a short wooden stopper in its stead that will pass the shaft pieces when the barrel is rolling. The lag

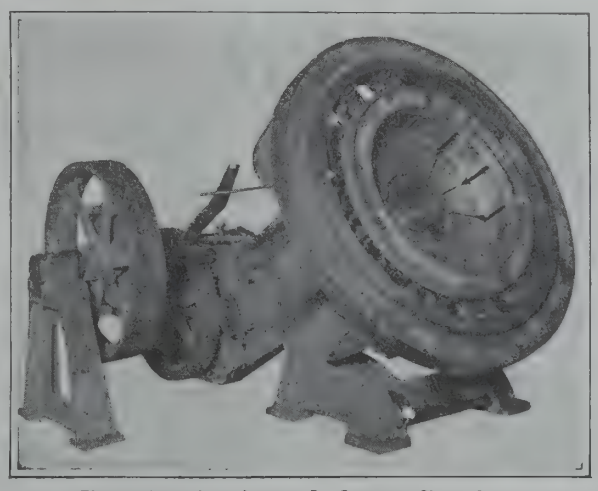
**A "lawn" of concrete and green paint**

screws form spindles for the rear ends of the shafts to turn on and the load can be carried up considerable grades without much effort. One might think it would not be a paying idea to consume the necessary time

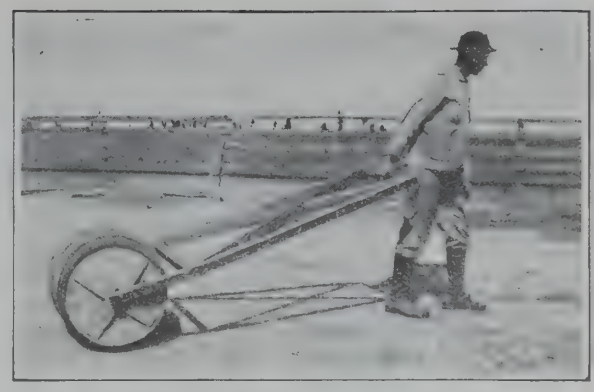


**Barge-mounted derrick that gives good service in San Francisco waters**

to prepare this rigging but it is to be considered that when a haul is made with this barrel you have fifty gallons where it is needed, whereas you would perhaps not have more than two with a bucket. Nothing



**Upsetting rims instead of expanding them**



**A handy substitute for the water bucket**

needs to be done to the barrel more than to bore a hole in one of the heads to draw off the water as desired if you prefer it to the bung hole in the side and there is but a trifle of expense to buy the material needed, only a few nails, two lag screws, a few scantling, etc.—By *L. M. Jordan.*

## The Concrete Lawn

THE waterless, mowerless, weedless, gopherless lawn has made its appearance in Los Angeles, according to a recent item in one of the local papers. Everything about this lawn is according to the usual specifications governing be-grassed and be-flowered front yards, with the single rather important exception that the "lawn" is of concrete, painted green. At a distance it doubtless looks pretty much like a grass lawn, though at close quarters we should think it might leave something to be desired, unless the proprietor (and inventor) has gone to the trouble of painting in individual blades of grass. The idea, of course, is to have a lawn that will stay fixed without any fixing—no mowing or cutting, no seeding, no rolling, no bare places, no trouble of any sort. Just how many people who care enough for the open to live in a neighborhood where the lawn problem exists, would be satisfied with this counterfeit presentment of a sure-enough lawn we do not know, but for all such, here is the idea.—By *Frank B. Howe.*

## Mounting Pictures Smooth and Flat

HOW many times have you pasted down a paper or mounted a print to find that when it dried it had buckled disappointingly? Ordinarily the paste is applied on the mount, the difficulty being that the exact limits to be thus covered is a matter of guesswork to meet the uncertain expansion of the print which is immersed in water before mounting; with the result that the print often exceeds the predetermined limits of the amount of the area covered with paste to receive it; on the other hand the print frequently falls within this area, leaving a margin of irremovable paste. The following method is free from such objections and difficulties: Keep the mount flat and with a small wad of cotton wetted in clean water, slightly dampen the approximate area to be covered by the print. Cover the back of the print with paste—preferably arabol—smooth and thin. Apply the print to the mount and with aid of a paper blotter and a small roller, smooth the print from its center outward. No paste will appear outside the limits of the print; any dampness exceeding these limits will evaporate. Any paper shreds left by the blotter, etc., may be wiped clean from the print's surface with the same damp wad of cotton.

## Tire-Rim Upsetting Machine

IN welding tire rims the method commonly used has been to weld the rim with the diameter less than the size required, and afterward expand the rim while cold to the correct diameter. For this purpose a tire-expanding machine was used and a low carbon steel is required as high carbon steel is more liable to break in the stretching process. In order to use the upsetting principle to obtain the correct diameters a new machine has been developed by a Chicago manufacturer. This machine contracts a tire rim to the correct size instead of expanding it. It differs from the usual tire setting type of machine in being motor driven instead of employing hydraulic power and the rim is held nearly vertical instead of in a horizontal position while being contracted. A toggle motion controls the jaws or dies and a combined movement of 3¼ inches across the diameter of the circle is obtained. The machine in operation runs continuously and makes eight strokes per minute. A wedge adjustment operated by a handwheel is provided to take up wear or to suit special conditions.—By *Allen P. Child.*

# Items In Brief

*A Department Devoted to Current News in All Fields of Pure and Applied Science*

## *Power and Fuels*

**The Gasoline Situation.**—There is no mystery in the existing shortage of gasoline on the Pacific Coast. It is not a case of diminished supply—the Far West has never had so much gasoline as this year—but one of increased consumption. The refineries of California are this year manufacturing a greater volume of gasoline than last year, and great quantities are being brought to the Far West from Mid-Western fields and Mexico. Yet, this larger supply does not satisfy the enormous demands of the scores of thousands of additional automobiles, trucks, farm tractors, gas engines, pumps and other equipment dependent upon gasoline for power.

**A New Heating System.**—Building superintendents and heating engineers will be interested in a piping layout for a heating system that provides a closed-loop circuit, whereby the water of condensation from the radiators is returned directly to the boiler. With the system is used a duplex boiler feeder, according to *Power*, which permits a continuous flow of condensation into the boiler. The condensation is held under pressure and is delivered into the boiler at a temperature only one or two degrees below that of the steam, corresponding to the pressure carried on the heating system. These results are obtained without the use of a receiving tank. There are no vents open to the atmosphere and practically no heat loss.

**Cleaning the Air** for internal combustion engines without materially reducing the engine power is a problem that has received considerable study, and a number of devices for the purpose have resulted. One of the more recent of these deposits the dust on the walls of a winding passage kept wet with oil. The upper portion of a disk which revolves at about ten revolutions per minute, intercepts the air, and as the revolution continues, the dust is washed off and settles in the oil bath, from which it is removed as required. Cleaning the device is said to be an easy matter. It is claimed that power loss due to the cleaner is greatly reduced because the air is not required to pass through the oil and the air flow is therefore not strangled.

**Natalite—A New Motor Fuel.**—It is reported by the London Automobile Association and the daily press that natalite, the new motor fuel (so called by reason of its discovery in Natal, South Africa), has been in use in that country for some time past, is well spoken of, and has had many favorable reports upon its practicability as a gasoline substitute. It is said to be a by-product of the Natal sugar industry, and is reported to be a mixture of power alcohol and ether, capable of great development, in view of the large tracts of waste vegetation available in South Africa. A British research committee is now engaged in making regulations respecting the use of this fuel, especially the necessity of denaturing the liquid to prevent its possible use as an intoxicant.

## *Transportation*

**The U. S. Navy's Swiftest Vessel.**—Steaming at the rate of 38.257 knots, the U. S. "Satterlee" in her recent official trials broke all American speed records. The best previous record made by an American war vessel was 37.04 knots. The "Satterlee" is driven by two 14,000-horse-power Westinghouse compound turbines which developed 31,223 horse-power and broke all records for vessels of this, the destroyer, class.

**The Very Necessary Horse.**—The regular dealers in New York City who make a business of purchasing high-class draft horses and assembling them in pairs report that they have never had such a demand for good draft horses and that prices have never been as high as during the months of March, April and May of the present year. The reason for this is that horses and mules are still the chief source of motive power in agriculture and draying. They have been read out of existence a good many times in the world's history. Nevertheless, the United States Census for 1910 revealed 19,833,000 horses and 4,210,000 mules on farms, and the estimates of the Department of Agriculture for January 1, 1920, show 21,109,000 horses and 4,995,000 mules on farms, an increase of 1,276,000 horses and 785,000 mules in the last decade. In addition to this, we exported in the nine-year period ended June 30, 1919, 1,149,763 horses and 376,836 mules.

**Growth of American Shipping.**—On June 30, 1920, the close of the fiscal year, the shipping registered, enrolled or licensed under the American flag, according to the official returns of the Bureau of Navigation, Department of Commerce, comprised 28,150 vessels of 16,350,000 gross tons. Final returns of smaller vessels built, lost, or abandoned will change slightly these figures one way or the other, but probably not to the extent of 100 vessels and 12,000 gross tons. Since January 1, 1919, closely following the armistice, American shipping in round numbers has increased 5,000,000 gross tons, and during the fiscal year just ended the increase has been 3,400,000 gross tons, of which 3,100,000 gross tons are documented in the name of the Government, represented by the Shipping Board.

**Again, the Hydraulic Propeller.**—The principles of operation of the Hotchkiss hydraulic propeller are, briefly, the formation of a vortex in a drum or casing, by the rotation of an impeller, the vortex discharging tangentially to give the thrust, and being fed in the direction of rotation by two converging streams which meet immediately over the discharge stream. By rotation of the drum casing the discharge stream may be moved so as to flow through a reversing port, and thus maneuvering can be carried out independently of the direction of rotation of the engine. The drum casing is carried in an outer drum or casing containing the reversing port; a further movement of the control lever rotates the inner drum until both the inlet ports and the discharge cutting are masked by the outer casing. The propeller is, therefore, converted into a sealed drum, with neither inlets nor outlets, and since pumping ceases, all of the load other than frictional is taken off the engine, and a hydraulic clutch is the result.

## *Engineering*

**Fitting the Roof to the Factory.**—Too little attention is generally given to the roof of the factory by the architect, when, as a matter of fact, the roof is just as important as the floor plan. Indeed, there are several types of roof available today for factory purposes, and the plans of any factory should always take into consideration the type of roof best suited to the requirements.

**Making Money By Destruction.**—Owing to the high cost of building materials, about one-third of the materials from a house-wrecking operation may be used again for building purposes. Formerly the house wrecker's chief concern was to take down the construction in the least possible time and at the least expense to himself; but today he also figures on ways and means of removing said construction with such care as to secure much valuable building material. It is well within the memory of most of us when salvaged bricks sold for $1.00 a load with 2,000 bricks to a load. Today salvaged bricks bring $10.00 and in some instances as high as $15.00 a thousand.

**Sea Bathing in Paris,** which, as everyone knows, is an inland city, is soon to be realized. Water from the sea is to be conveyed to the French capital by a long pipe line which has been planned by M. Alvarez of the Department of Roads and Bridges, as corollary to the scheme for bringing "mazout" or heavy oils from Havre to Paris by means of pipe lines three feet in diameter. Two such pipe lines are to be built, and a third line is planned for conveying sea water to a huge reservoir near Paris, where tired workers might rebuild their vigor and health over Sunday. The great cost of the pumping installation has stood in the way of the project, but it has now been suggested that the pumps be reversed during winter months for the purpose of pumping water from the Seine to the sea, in this manner reducing the danger of floods.

**Points on Roads.**—As loads are transmitted from the wearing course to the foundation and from there distributed to the subgrade, the bearing power of the soil composing the subgrade is an important factor in the design of the highway. It is well known that the bearing power of soils in many instances is materially increased by efficient drainage. The roadway, therefore, should be drained so that the maximum wearing power of the subgrade is developed, according to A. H. Blanchard, S.A.E. While a poorly drained roadway might support a light rural traffic, it will be rapidly destroyed if subjected to commercial motor transport including, for example, several five-ton trucks. The greatest improvement noted in American foundation practice is the use of cement-concrete foundations, or stone foundations of equivalent strength, on State trunk highway systems.

**Organic Impurities and Concrete.**—Tests made in the Structural Materials Research Laboratory with the coöperation of Lewis Institute and the Portland Cement Association show that the long recognized injurious effect on concrete of organic ingredients is a fact. The following conclusions were reached: The strength of concrete was reduced for all percentages of tannic acid, for all mixes and ages covered by these tests. Less than 0.01 per cent of tannic acid in terms of the weight of the aggregate may reduce the strength of the concrete to one-half its normal value. Lean mixtures are more affected by tannic acid than rich ones. The mixtures from the finer aggregates are less affected by tannic acid than those from the coarser aggregates. All of the effects mentioned may be summed up by saying that the reduction in strength of concrete is a function of the concentration of tannic acid in the mixing water.

**What Makes Rails Wear Out?**—It is pointed out by an authority that the ordinary car traffic is not entirely responsible for rail wear. The constant traffic of ordinary road vehicles has a considerable wearing influence. In a general way rail wear is dependent on the operating speed of the car, weight of equipment, density of traffic, use of brakes, frequency of stops, grades, alinement with respect to curvature, design of rails, design of wheels, upkeep of wheels, use of sand, cleanliness of streets, and manufacture and composition of the rails. Curves prepared by this authority indicate that a traffic of 216,000 cars at a speed of 18 miles per hour produced in three years the same wear as a traffic of 320,000 cars at a speed of 9 miles per hour in four years. In a single-track line the wear is seldom greater, and is frequently less, than in a double-track line: an apparent paradox which is probably explained by the reversal of direction of traffic, which tends to neutralize cold-rolling actions in the surface of the rail-head.

## *Industrial Progress*

**Belgium's Diamond Industry.**—The number of union workers in the diamond industry in Belgium reported to be out of work is 6,500 out of a total of 12,000. Owing to a falling off of the demand for cut stones, employers are seeking to decrease wages 35 per cent. The diamond workers' union has objected to this, and is unwilling to accept a diminution of more than 15 per cent. The matter is being arbitrated. In the meantime hundreds of employes are seeking other work.

**Italy's Mining Industry.**—Among the Italian industries which progressed most during the war was the mining industry. In 1914 it comprised 1,062 mines, employed 46,412 workmen, and the output was valued at 96,500,000 lire. As regards amount of mineral extracted, the sulfur industry came first with 2,371,705 tons of ore, followed by coal and lignite, with 781,358 tons of product; iron ore, with 706,246 tons of product; iron pyrites, with 335,531 tons; and asphalt, zinc and mercury. Since 1914 Italian mining activity has been directed with more or less success toward the following ores: Iron, manganese, copper, lead, zinc, gold, antimony, mercury, tin and mixed ores; also toward iron pyrites, anthracite and lignite, ichthyolitic and bituminous schists, sulfur, rock salt, salts from springs, petroleum, carburetted hydrogen gas, mineral waters, asphaltic and bituminous rock, raw bitumen, aluminite, boric acid, and graphite.

**Spitzbergen's Natural Wealth** is again brought to our attention by the *Times Trade Supplement*. It is said that a totally new and, until the last few years, quite unsuspected source of fuel oil exists in Spitzbergen. The existence of oil-bearing shales in this far-off land has been known for some years. It is not

generally known, however, that a discovery of much greater portent than the existence of shale was made there last year. Samples of gas which bubbled to the surface of muddy pools have, on analysis, proved to contain an exceedingly high percentage of petroleum elements. Arrangements have been made by the owners of the territory thoroughly to prospect the region at once. There is great scope for industrial development in the islands, for, continues the *Times*, though only a small portion of their area has so far been prospected, during the past few years they have been proved to contain much mineral wealth.

**Cologne's Permanent Exposition.**—Cologne is planning to inaugurate a permanent exhibition, known as "Musterschau," mainly for raw material and half-manufactured goods. It is intended that special exhibitions will be held periodically. For the use of the exhibition two large halls of iron construction, 4,000 and 7,000 square meters, respectively, are already in the course of erection, to which smaller buildings will be added according to requirements.

**Italy's Floating Sample Fair.**—The success of the sample fair held both at Milan and at Padua seems to have been sufficient to stimulate further interest in this plan of developing sales. It is claimed that at the Milan fair actual orders amounting to 500,000,000 lire were taken. Figures for the Padua fair are not yet available. The latest project of this kind is that of a floating fair on board the steamship "Trinacria," which will cover the principal cities of the Western Mediterranean in the interests of Italian manufacturers. The length of the stay in each port will vary in accordance with its importance, from four to seven days. The cost to exhibitors will be 5,000 lire, in which all expenses are included.

**Signing Foreign Correspondence.**—Those who are familiar with commercial practices abroad understand that all correspondence addressed to foreign business houses should be signed by some one in authority—a member of the firm in the case of a partnership, or an officer of the company, or at least the export manager in the case of a corporation. It appears, however, that there are many American firms who use a rubber stamp, or the signing is done by some clerk occupying no position of authority. In a number of cases this has been unfavorably commented upon by European business men, who, quite naturally, wish to deal directly with the principals, and to be assured that the firms with which they are dealing are prepared to stand by the statements made in their letters.

## *Automotive Progress*

**Wood Disk Wheel.**—An automobile disk wheel made of wood has recently made its appearance after a series of tests both on the road and in the laboratory, according to *Automotive Industries*. The construction, which resembles in appearance the steel disk wheel, is of thin, rotary cut slices of wood, glued together under heavy pressure. The laminations are so built up that the grain of each piece runs in a different direction from that of the next piece, thus producing a result that is claimed by the makers to be strong, non-warpable, and thoroughly waterproof. Road shocks, it is declared, are distributed evenly.

**Steam Wagons.**—Europe, and England in particular, has long stood by the road locomotive which resembles nothing more than our steam road rollers. Now there is being developed in England a steam wagon which follows the general lines of the conventional gasoline truck. However, the steam power plant makes use of a regular boiler and firebox for coal. The framing of the wagon chassis is of pressed steel instead of the more usual channel iron, thus permitting of a lighter structure and one better proportioned to the stresses it has to carry. The final drive from the engine to the road wheels is by means of a pitch chain, as usual in vehicles of this type.

**French Automobile Manufacturers** are considering the United States as a market for their cars, according to a recent dispatch from Paris. Mr. Pierre Bassett, representative of the Syndicat Français des Constructeurs d'Automobiles, will leave France shortly to investigate conditions here and on the basis of his report will map out their sales campaign. Due to the French exchange situation and the low cost of freight space on ships returning to the United States, Mr. Bassett expects to place French trucks on sale here at prices which will compare favorably with local prices. Moreover, many of the large French concerns have developed considerable technique in fast construction. Their appeal will be directed toward customers in this country who are willing to pay the higher price for "something different."

**Magneto or Battery Ignition?**—Considerable interest has been expressed by engineers as to the relative power output of engines equipped with magneto and battery ignition, respectively. A test was recently made at McCook Field, Dayton, Ohio, for the purpose of comparing the results obtained with both types of ignition. A 180-horse-power Hispano-Suiza was equipped with a magneto for part of the test, and then with special battery ignition. The difference in performance was very slight. Practically the same power was obtained using either system. The gasoline consumption remained about the same in each case. However, as regards weight, the two magnetos, weighing 14½ pounds each, one starting magneto of six pounds and one switch of one pound, made a total of 32 pounds, while the battery ignition, calling for the motor units, distributors, breakers, coils, and so on weighed altogether 30 pounds, the ignition battery 10 pounds, the switch and regulator 2 pounds, giving a total of 42 pounds.

## *Communication*

**The Chinese Wireless Station** at the Temple of Heaven, Peking, is open for service. All the telegraph offices in the city are accepting radiograms at the same rates as those charged for land-line messages for transmission to Kalgan, Wuchang, Woosung, Shanghai, and Foochow. Special rates apply to radiograms sent to ship and aviation stations. This service gives Peking improved communication with some of the most important commercial centers in China.

**The Rome Wireless Station.**—It was in 1917 that the Italian Government planned the wireless station at Basilica of San Paolo, near Rome. It was decided on account of the necessity of rapid construction to use continuous waves, and for similar reasons the Poulsen arc system was adopted. The antenna chosen was one having the shape of an equilateral triangle supported by three cables more than 200 meters high, with down leads coming from one of the sides. The station is quite capable of receiving messages from American high power stations, but its transmitter does not maintain continuous touch with the American stations.

**Marconi's Wireless Telephone.**—In his recent experiments Marconi used a 15-kilowatt, 500-volt, 200-cycle generator supplying current to a 20,000-volt transformer, tapped at the secondary middle point. Two rectifying valves cause a condenser to be charged to half the total secondary voltage uni-directionally once every half-cycle, maintaining the condenser charge at about 10,000 volts for the supply of the transmitting and low frequency magnifying valves. To eliminate the distortion of the harmonics in the speech waves, and to obtain the best quality of speed it has been found that the best method is to absorb the energy in the aerial in accordance with the speech wave formed. This is effected by stepping up the microphone current to produce voltage curve similar in shape to that produced by the varying current caused by speech by means of a two-stage low frequency amplifier. The voltage variations are thus magnified and are impressed on the grids of the absorption valves. As is well known, the resistance of a three-electrode valve varies with the voltage impressed on the grid, so that in this case the conducting power of the absorption valve varies with the voltage curve produced by speech.

## *Electrical*

**Production of Electric Lamps.**—For the year 1919 sales of all kinds of lamps in the United States amounted to 183,000,000, and although this is 3,000,000 less than in 1918, the diminution is not substantial. An interesting feature is the diminution in the percentage of carbon filament lamps made. This has fallen from 11 per cent to 7 per cent in 1919. It is also interesting to note the increase in the use of gas-filled lamps, of which 24,000,000 were sold in 1918, as compared with 27,000,000 in 1919—a rise of 12½ per cent. Most interesting of all, no doubt, is the fact that the average candle power of lamps is steadily increasing.

**National Electrical Safety Code.**—The present edition of the *National Electrical Safety Code* was issued in 1916 for examination, trial and constructive criticism. It was realized that the code was not a perfected document and that experience should be obtained with it before the rules were made mandatory. War conditions delayed the expected trial, and although revision has been almost continuously under way, it was not until the present year that sufficient information and consideration of the rules could be obtained to warrant the publication of a new edition.

**Electro-Pneumatic Welding Machine.**—In operating spot-welding machines of the usual type the pressure required for the weld is produced by a foot pedal. This is tiring to the operator, especially as he may have to make 15,000 welds per day. The electro-pneumatic welding machines now being built in Germany are equipped with a compressed-air cylinder controlled by a foot pedal, which requires very small effort to depress. The motion may also be regulated by a small motor that actuates the mechanism a given number of times at the required intervals. By this device the capacity of the welding machine may be increased by 50 per cent.

**Electrification of Japan's Railroads.**—According to the provisions of the bill introduced in the Diet for the complete electrification of the railroads of Japan, the Government would invest 50,000,000 yen in a semi-governmental electric power company, which would be capitalized at 100,000,000 yen, the other half of the capital stock to be subscribed by Japanese citizens or bodies incorporated under the laws of Japan. It is further understood that the Japanese Government contemplates erecting the largest hydro-electric plant in Japan on the River Shinanogawa near Tokio, which would probably be supplemented by a large steam plant also near Tokio.

**Remotely Controlled Electric Locomotives.**—In a recent issue of the *Electric Journal* there appears an interesting account of a remotely controlled electric locomotive. The motorman first brings the locomotive with eight empty cars and spots the first car under the loading chutes at the screen station of the coke plant. The motorman then throws a switch and places the locomotive under the control of the operator in the screen station and leaves the locomotive. The operator then slowly moves the train forward, stopping or reversing it as conditions may require, thereby securing an evenly and completely loaded car. When the cars are loaded the motorman returns to the locomotive and draws the cars to the classification yards, returns for empty cars and the cycle is completed.

## *Chemical and Metallurgical*

**Alloyed Aluminum.**—Much progress has been made of late in the development of new aluminum alloys, especially for use in the automotive industry. The most sensational step, according to a leading authority on this subject, is the evolution of a forging alloy which promises to accomplish much in automobile engine design, in the way of cutting down the reciprocating weight and in reducing rotating masses and bearing pressures. The physical properties which have so far been secured in the forging alloy are said to be 55,000 to 65,000 pounds per square inch tensile strength, with 18 to 22 per cent elongation and 38 to 40 per cent reduction in area.

**Use of Manganese.**—Approximately 95 per cent of the manganese consumed in the United States is used in making steel not only to deoxidize and recarburize the molten metal, thereby making possible the production of cleaner and sounder ingots containing the desired amount of carbon, but also to impart certain qualities to the finished product. Small proportions of manganese, 0.5 to 0.8 per cent, make the steel easier to work and stronger in service. At the same time slight proportions of impurities remaining in the steel are taken into combination and rendered less harmful. Relatively small quantities of so-called "manganese" steel are made which contain 11 to 14 per cent or more of manganese and possess special qualities of hardness and strength.

**Electrolytic Purification of Clays.**—The electrolysis of colloidal solutions has led to the application of this principle to the purification of china and other clays. If clay is mixed with water and certain alkalis are then added to the solution, the mixture settles and becomes more liquid. If, now, an electric current is passed through the solution, the particles of clay connect at the anode, while the impurities (mica, felspar, quartz, iron compounds) either are precipitated or migrate to the cathode. On an industrial scale the process is carried out in a large vat, in which slowly rotates a metal cylinder forming the anode, and near which the cathode is placed, continues *L'Industria*. The clay paste, after the electrolyte is added, is left to clarify in other tanks, being then passed into the electrolyzing vat for final purification, when it is collected by special rakes. In addition to being pure, clay thus treated has a lower temperature of agglomeration, molds more easily, and is more plastic and refractory.

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

**Speaking into this telephone, the guard projects his voice through several loud-speaking telephones**

## An Electrified Voice for the Subway Guard

RELIEF from the inarticulate sounds emanating from the guards in announcing subway stations is in sight. It is to come in the form of a loud-speaking telephone developed by E. E. Trafton, telephone engineer of the Brooklyn Rapid Transit system of Brooklyn, N. Y.

It is claimed that the operation of the new loud-speaking telephone entails little effort on the part of the guard, who speaks in an ordinary voice through a transmitter located at the central panel which contains the push-buttons controlling the doors of the car. Loud-speaking units are installed on the ceilings of the car, so that the voice of the guard is greatly amplified and distributed throughout the car. The transmitter, into which the guard speaks, is provided with a button for throwing it in and out of circuit, as well as a peculiarly-shaped mouth piece with four petals instead of the usual cone shape.

## Speeding Up the French Fried Potatoes

THOSE French fried potatoes which many of us ordered when porterhouse steak was within the reach of us all, are not easily prepared unless some special device is used for the cutting. Here is one that has been invented recently and that seems to put speed into the preparation of this much favored item of the menu card. Mounted on the top of a nickel plated hollow base is a square surface across which numerous cutting blades are strung. By pushing the potato through the cutting squares they fall below ready to be cooked.

**Pushing the potato down on this device paves the way for French fried potatoes**

## For Handling the Camper's Baked Potatoes

THOSE of you who are camping or who are planning a trip out into the great out-of-doors in the future will find this newly-designed cooking utensil useful. It is called a pusher fork. By manipulating the spring handle, corn or hot baked potatoes can be picked up and served on a plate without burning the fingers. Our illustration shows the potato being pushed from the fork. By releasing the thumb on the spring handle the small "pusher," which slips along the tines to the end, will fall back into position near the point where the tines join. The "pusher" cannot go beyond the end of the tines.

**There need be no burnt fingers when handling potatoes with this pusher fork**

## More Heat from Less Coal

THE older houses and apartments in the Malmo section of Sweden are provided with very simple cast-iron cooking stoves. The newer buildings, however, are equipped with gas cooking apparatus almost exclusively. Gas is available in nearly all cities in southern Sweden, and is more generally used for cooking than for light. Buildings constructed more than 10 years ago have few furnaces, but are heated by high tiled stoves, which are characteristic of all Scandinavian countries. These tiled stoves can be opened so as to produce a fire-place effect. The new houses, villas, and apartments are provided with furnaces burning coal or coke. Hot-water heaters are more frequently found than any other kind. The coils and radiators are quite modern in design and compare favorably with those in use in other progressive European countries.

Most of the heating and cooking apparatus is produced locally in the industrial region of central Sweden. The principal imports before the war came from Germany. The Germans shipped more gas cooking stoves to southern Sweden than other kinds. The German stoves are more modern than those produced in Sweden. Imports from other countries were small.

## Agricultural Exposition to Be Held in Belgium

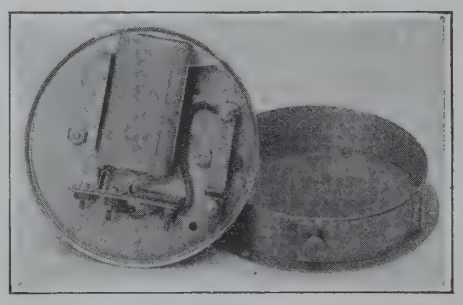
THE legation of Belgium at Washington has announced that an exposition of agriculture and agricultural husbandry will be organized at Laken-Brussels in September, 1920, under the patronage of the Ministry of Agriculture of Belgium. The object of the undertaking is to bring together the implements most useful to agriculture—machinery, furniture, experimentation, and instruction.

The Minister of Agriculture of Belgium has expressed a wish that the exposition be made known to the industrial and scientific special centers which in the United States are most interested in the furniture, apparatus, and implements, and also the methods and arrangements by which labor can be saved on the farm and in the rural household.

Firms interested in an exposition of this kind can communicate with Mr. De Vuyst, Director General of the Ministry of Agriculture, Place Quételet, at Brussels, with a view to sending to the exposition all novelties and specialties that come under the head as above outlined. Exhibits which the owners would be willing to leave to the superior normal institute of agricultural husbandry after the exposition would be used in the museum that would be periodically opened to the public.

## Bringing Buzzer and Battery Together

A NEW design of electric buzzer has appeared that does not require a dry cell outside of the bell itself. The buzzer uses a flash-light battery which is concealed within the casing of the bell. It is so made that it can be operated at some distance or by using the push buttons installed on the buzzers. The binding posts on the right and left of the push button can have proper wire connections for some outside use of the buzzer. In the bottom of the metal case, upon which the bell is mounted, is a small door. By opening this a worn flash-light battery can be removed and another pushed into its place. The coils of the electromagnets are wound for about 8.5 ohm. where a 2-cell battery is employed. Buzzers are all made for the 2-cell battery, with a 2½ gong.

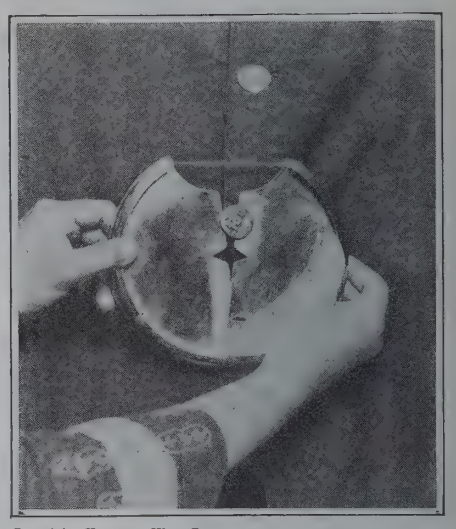


**This buzzer is entirely a self-contained unit, having its own battery**

## Polishing Brass Buttons Without Spotting the Uniform

IT has come to be a popular belief that women are not inventive. Yet time and again we find some ingenious idea conceived by a woman; and the truth of the matter seems to be that women, unlike men, do not invent unless they are driven to it, so to speak. In other words, women will invent through sheer necessity.

Such is the case with Mrs. Hannah Schachne of New York City, the wife of a policeman, who has invented a new and less tedious method of cleaning buttons on all uniforms. Mrs. Schachne has been cleaning her husband's brass buttons for years and great care has had to be exercised not to spoil or ruin the cloth around the buttons. So in her search for a better way to do this work, she invented the simple shield shown in the accompanying illustration. The action of the shield is self-explanatory.



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**This simple shield protects the uniform while the buttons are being polished**

## A New Partnership: Phonograph and Alarm Clock

IT may be that the war has something to do with it; so many of our young men have learned to get up in the morning to the tune of the "Reveille" that it is hard to get along with the more conventional alarm clock. At any rate, Oscar Lindholm, a machinist of Chicago, Ill., has invented the alarm clock-phonograph, shown in the accompanying illustration. In this device use is made of a standard alarm clock for the purpose of starting the turntable of a standard phonograph. The clock can be set for any desired time. When the clock "goes off" it starts the turntable of the phonograph. In this manner it is possible to vary one's rising call. One day it may be a good cornet solo; again it may be a popular song of the moment; still again, it may be a crashing military march. Or if one desires a personal tone in the summons to arise, it may be a man's or woman's voice. At any rate, the phonograph has another useful mission to perform.

**The alarm clock starts the phonograph which plays any desired music to get one out of bed**

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## Dependable service has established "Z" engine dominance

The American farmer today is using more than two hundred and fifty thousand Fairbanks-Morse "Z" engines.

He lights his home with the electricity it provides, operates with it his separator, churn, feed-grinder and ensilage cutter. His sprayer is likely to be powered with a "Z" engine. In the South it loads his sugar cane and performs a host of other labor-saving tasks.

The ease with which the "Z" does these farm chores has created for it also a widespread demand for industrial uses.

In the machine shop, the mill and the printing office, "Z" engines are delivering consistent day-by-day service. Out in the open they are pumping water, operating concrete mixers and furnishing power for hoists and other construction machinery.

The successful service of the "Z" engine in agriculture and industry is another step toward the goal reflected in the Fairbanks-Morse Quality Mark.

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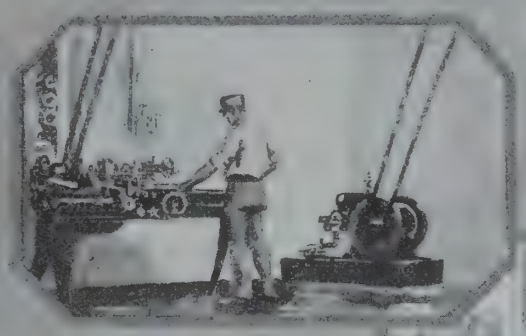

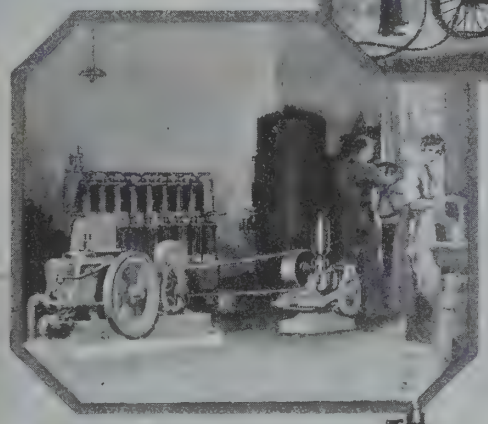

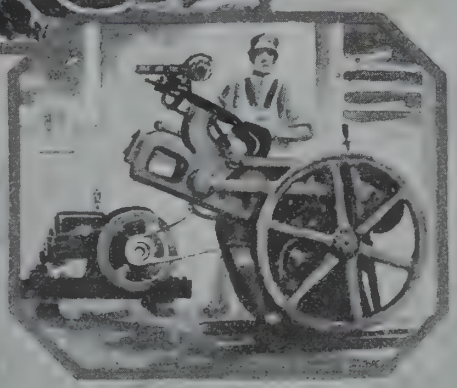

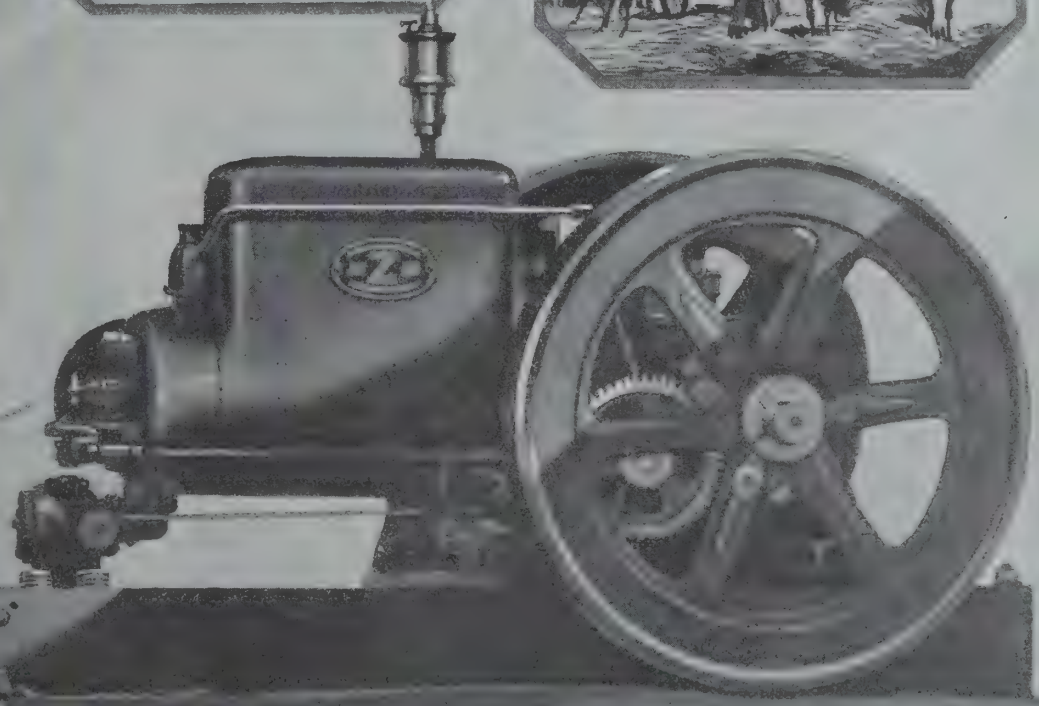

# Stale Air Out Fresh Air In

YOU can't get fresh air **in** unless you get stale air **out.**

Generally the stale air rises at first, because it's warmer than the fresh outside air. Give it free exit near the ceiling, at the same time opening inlets near the floor, and the stale air slips quietly out while fresh air takes its place.

But if the stale air is kept indooors it presently cools, descends, and mixes with the lower air. Thereafter the stale air cannot be separated from the fresh air unless there is a wind blowing across.

With properly-placed **upper and lower** ventilators, even a wide building will have fresh air. But how many buildings do you see that have only one row of ventilators, located about midway of the sash height? Such a building cannot be adequately ventilated without a cross wind.

The building here shown is an example of good design, using Lupton Pivoted Factory Sash with connected upper and lower ventilators. We are always glad to advise intending builders regarding the best choice and arrangement of sash for their special needs.

We have published an interesting booklet, "Air, Light and Efficiency." It's free on request.

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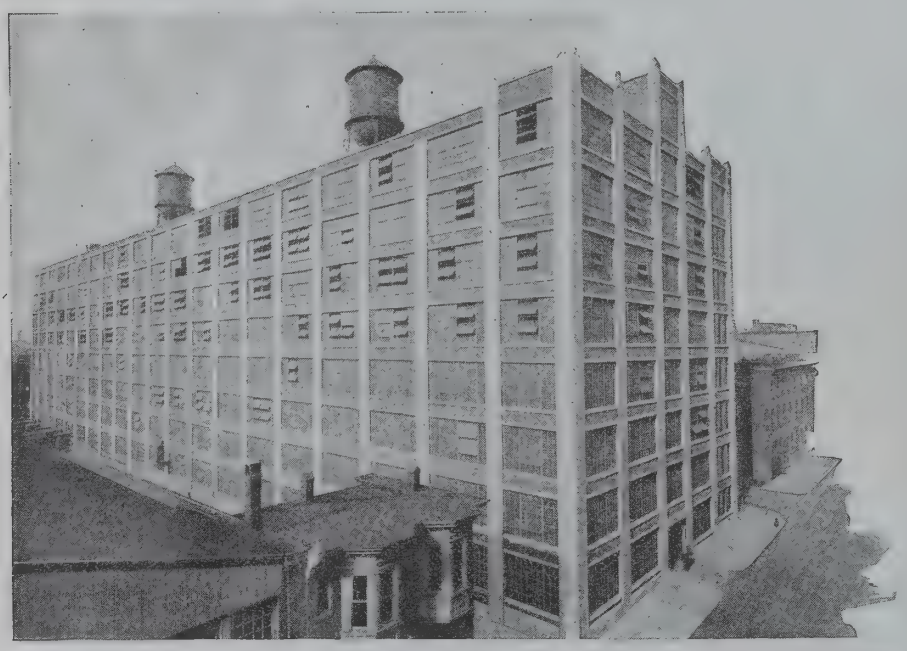
"Today —— the Sash makes the Factory"



Baldwin Locomotive Works, Philadelphia. Fred Jasperson, Engineer. Lupton Pivoted Factory Sash used, with connected upper and lower ventilators.


## New York's Radio Pilot Cable

(*Continued from page 195*)

breaking the cable current in order to transmit signals; in fact, an automatic sending apparatus may be installed so as to send out given signals over and over again when necessary.

So much for the cable. Now the receiving end aboard ship is quite as simple. Two coils are required, each four feet square and wound with 400 turns of No. 24 S.C.C. copper magnet wire. Care should be exercised in making these coils so that each coil will have the same resistance and inductance values. Much depends upon this precaution as the signal strength received by each coil is the function of the resistance of each coil, and should their resistance be different, a signal strength of different intensity will be received by each coil when at the same distance from the cable. The best shape for the coils is the pancake. The wire can be wound in pancake form four feet square, with a winding space of one inch. The coils are impregnated in paraffin and then placed in wooden boxes with more paraffin in order to protect them from abrasion.

The coils should be placed over the side of the ship approximately amidship, one coil on one side and the other coil on the opposite side, below the surface of the water or slightly above the water line.

## Gas Engine Versus Steam Engine

(*Continued from page 197*)

tion by means of these two modern vehicles, which, coupled with the good-roads movement in California, are re-forming the whole social and industrial world.

California is one of the foremost States in the Union in the voting of bonds for the construction of good roads. The work was begun in 1909 when the State Highway Appropriation Act provided for a State bond issue of $18,000,000 for the construction of highways. The work of construction was begun as soon as this fund was available. But the enterprise loomed so large, as the work went on, that the fund provided appeared entirely inadequate. Accordingly on November 7th, 1916, another bond issue of $15,000,000 was voted by the State to further prosecute the work of good road building. Then there came an actual craze for good roads in California, and eventually a special election was held and a third bond issue of $40,000,000 authorized.

This building of good roads has only stimulated the use of the public motor truck and auto stage. "Ship-by-truck" has become a popular slogan in California, and the truck and tire interests are boosting the movement with the greatest spirit and vigor.

The problem of the short haul by truck appears to be working out automatically and to be far on the road to solution. The truck as an individual carrier has asserted itself, and nothing appears to threaten its permanency. The truck as a common carrier is still in its experimental stage. But the thing has such great promise, is the subject of so much enthusiastic effort and is surrounded by so much freedom of action that it seems to have a brilliant future.

## A Neat Problem in Hydraulics

(*Continued from page 198*)

walls of steel sheeting at intervals of, say, 300 or 400 feet. The piling was one of the standard forms of rolled sheeting. That is, each pile is a single "plank" of steel without rivets or bolts. The edges are given such forms as to enable each pile to interlock with its companions on the two sides. There are several such varieties of steel sheet piling in use. They are American triumphs in the art of rolling steel. When assembled, the particular size of piling here used provides a covering 14 inches wide per pile.

(*Continued on page 212*)


LEGAL NOTICES

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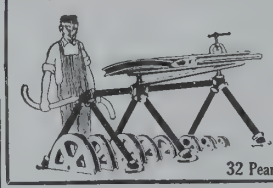
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# *The Men who Distribute the new Leland-built Lincoln Car*

Those who know motor cars, know that high character and soundness in the organizations which produce them, should be paralleled by like character and soundness in the organizations which distribute them—the men who form the connecting links or points of contact between the car owner and the manufacturer.

The distributing organizations of the Lincoln Motor Co. are in fifteen cities, including a factory sales branch in Detroit.

As production increases, additional distributors will be selected from the nearly 2,000 applicants already in waiting. Many of these, even now, have lists of priority orders and orders conditional upon their appointment.

In the fourteen cities where sales franchises have been granted, selections were made from among 416 applicants.

In not one single instance was it a matter of soliciting a distributor, nor of accepting whomsoever could be obtained. In every case it was one of our own choosing—of selecting those who we believed to measure up to the standards we had established, and whose high standing in their respective cities had been abundantly tested.

Nor was this a simple procedure, because most of the applicants were distributors well established, of high repute, and already handling cars of the better class. They were men who have made it their business to know motor cars and motor car builders.

With this type of applicants it was a matter of carefully choosing those best qualified.

LELAND-BUILT
LINCOLN

Most of them have had sales franchises continually thrust upon them for consideration, and could obtain almost any franchise merely for the asking.

We have selected organizations and men accustomed to contact with the highest type of citizens —the class to whom the Leland-built Lincoln car will naturally appeal.

They are men cognizant of their responsibilities; men who are not unmindful that upon delivery of a car to the purchaser, their duty has just begun.

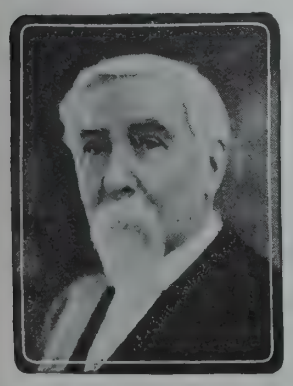
These men have shown the faith that is in them by cooly and deliberately obligating themselves to merchandise millions of dollars worth of motor cars—cars of whose features, and details, and price they were wholly without information.

And their faith is further evinced, in most of the cities, by the erection of modern and adequate structures, quite in keeping with the product and with the clientele.

Their faith in the car, and in the organization which produces it, is confirmed by the faith of more than one thousand of the best citizens who, likewise without definite knowledge of the car, its features, its details, or its price, insisted upon filing priority orders—without encouragement from the factory, and seldom with encouragement from the distributor.

Their faith too, is not without judgment. They know the organization behind the car. They know the character and the accomplishments of the men behind that organization; they know their works and their record; they know their ideals in motor car engineering and motor car construction; they know their forward vision.

Above all, they know the Leland determination and Leland ability to achieve—and to surpass.



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*President*

*Wilfred C. Leland*
*Vice-Pr. & Gen. Mgr.*

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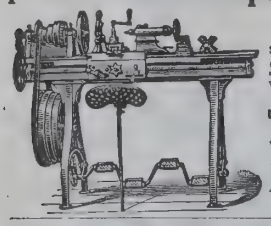

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## A Neat Problem in Hydraulics

(*Continued from page 210*)

Naturally, the actual width of each pile is something in excess. Altogether, the number of lineal feet of piling used for this dock amounts to nearly 75,000. The weight of steel was some 3,100,000 pounds.

It will be remembered perhaps that it was pointed out that strata of hard white sand and cemented gravel overlie the red clay. The driving of the piles through these layers proved very difficult indeed. Some of the piles went down very well; but a large percentage of the total resisted strenuously the efforts of the pile driver. The piling was heavy and strong, weighing about 41 pounds per lineal foot; and yet much of it was later on found to have suffered a good deal from bending and tearing apart. Steel sheeting is ordinarily driven by blows delivered upon its head, usually through an interposed cap. Its stiffness, strength and edge thinness are relied on to secure penetration. As a rule, the pile goes down, cutting its way through the soil and even through buried trees and old lumber. But, here at the Navy Yard, not only was there the combination of the two difficult strata already mentioned, but also big boulders would at times be encountered. Under the almost resistless drive of the pile driver, the steel pile would at times be diverted by a boulder and curl up as if it were a wooden shaving made by a hand plane.

The dock is an enormous box of concrete, and a representative cross-section is not unlike a similar section of a lock. There is the heavy floor of concrete, and the massive side walls of the same material. At Panama the pouring of concrete in the locks was a problem that received more than one solution. At Gatun, the concrete on the very side was handled by cableways stretched transversely across the locks between movable towers shifting lengthwise the site. On the Pacific side, berm cranes serving towers on the center line were employed in at least two pairs of locks. Here in Philadelphia a giant crane not dissimilar to those used with ordinary locomotive crane units was mounted upon a wide-gaged track laid lengthwise of the dock on the one side. One pair of rails was laid on top of the side wall and the other on a concrete stringer supported by bents of bearing piles. This was the arrangement on the west side where the summit of the wall is narrow. On the east side the wall is quite broad. The great boom had a maximum reach of nearly 130 feet at which radius a load of 15 tons could be handled. At a radius of 92½ feet 50 gross tons was a possible load.

## What Has Been Said About Einstein

(*Continued from page 200*)

new and startling when put before us so bluntly as they have been since last December.

He might be a little clearer on some points—notably with regard to the circumstance that the element with which the four-dimensional manifold of space-time is concerned is not the "thing" as he so often has it, but rather the "event." But we would not be understood as criticizing Dr. Slosson's book too severely. It would be extraordinary if no suspicion of technical error were to be found in a discussion so completely and successfully toned down to the popular level. Of its kind this discussion is admirable, and its style is inimitable beyond all adverbial qualification. Our one regret after reading it is that we passed through the mill of Columbia too early to have attended Dr. Slosson's lectures. If he can talk as he writes he must have constant need of a "Standing Room Only" sign such as Dr. Eddington may be pictured as employing when the line of Cambridge students waiting to get into the hall where he was to lecture on Einstein mussed up the entire college grounds. And we may return to the Eddington volume right here to recommend the reading of the delightful three-cornered Socratic conversation between the physicist, the relativist and the mathematician, with which it opens, as an admirable prolog or epilog to the Slosson book.

Other books which have appeared in English for popular or semi-popular consumption might seem to call for attention here. But the fact is we can say nothing good of any of these, and in charity to the publishers who have trustingly supplied us with copies for review it seems unnecessary to say anything bad about any specific one of them. They may reasonably go by default, so far as this review is concerned, hiding their all-too-meager lights under a bushel. A word about magazine articles, however, may not be out of place here. Again it is to be understood that we make no effort to catalog everything that has been published, mentioning only those whose reading seems profitable in connection either with the preparation of an essay for this contest or with the preparation for reading such of these essays as may be published.

Dr. Eddington's article on Einstein in the *Contemporary Review* for December, 1919, is the best that has appeared in English, in our regard. It is fully covered by his book, however, so that one would not care to read the article after having perused or before perusing the book. His article on gravitation in the SCIENTIFIC AMERICAN SUPPLEMENT of July 6th and 13th, 1918, is perhaps a little more out of the track of subsequent discussions, and might well be read by a student of the Einstein doctrines. Of American articles, we prefer those by Dr. Stewart in our own columns under date of January 3rd last, by Mr. Lotka in *Harper's Magazine* for one of the spring months of 1920—the exigencies of going to press do not permit of exact determination of the date—and by Professor Cohen in the *New Republic*. The last named treatment is of value in that it emphasizes as we have seen emphasized in no other place the fact that the present accepted body of Einstein theory is really a composite of three independently promulgated researches—the first and the second, or the restricted and the generalized principles of relativity, and the theory of gravitation. As Professor Cohen says, a great deal of misunderstanding has been created through the overlooking of this circumstance in popular articles by semi-competent writers. But Professor Cohen himself transgresses rather seriously when he comes to discuss the geometric character of the space-time manifold, for he here states as an uncontroverted fact several conclusions on which Dr. Eddington himself was at last accounts not yet ready to express a final opinion.

Einstein himself is responsible for two articles which have been translated from the German in which he wrote them for popular consumption, and which have appeared quite generally in English These are not intelligible to a layman and not of any significance to an informed mathematician. It would appear that the great man is not at home when he tries to stoop to the level of common folk—a common enough phenomenon and one which should never be surprising.

## Fire Without Firemen

(*Continued from page 202*)

such installations that a steady fire, readily under control, be available. With hand firing of coal this would be impossible and fuel oil or gas would have to be used at greater cost.

Just as important as the stoker is the machinery for bringing the coal to the furnace and removing the ashes. At first thought it would seem that this is a simple conveyor problem that might easily be solved in any one of a number of ways. And so it is, in the case of the coal. In many of the large power houses the coal is fed from huge hoppers over the boilers, into which the coal is dumped directly from the cars. Or any one of the standard conveyor systems will prove satisfactory if conditions do not permit the simpler arrangement.

But ash handling presents a more difficult problem for solution. It was once a common practice to use the same conveyor system for both coal and ash but in practically all of the important installations now separate or "divorced" systems are used.

This is because the ashes are never "plain ashes." They are either dripping wet, red-hot, dry and dusty or full of big clinkers. If the ashes are handled wet they pack in conveyor cars and cake there. If they are handled dry a system must be used that will not spread the dust to all parts of the plant. The equipment must be heavy enough to withstand warping from the heat; there must be no exposed bearing or joints to be cut out by the abrasive action of the ash; and above all the conveyor must not consume too much power. In addition there is a safety problem for enclosed ash dust occasionally explodes with disastrous results. The severe conditions which ash conveyors must overcome may be realized from the fact that while the depreciation in ordinary conveying machinery is usually figured at 10 per cent, the depreciation for ash conveyors often is as high as 30 or 40 per cent.

There are six general schemes of ash conveying in general use, each best suited to a peculiar set of conditions. The machine handling of fuel from the car to the ash pile has introduced a multiplicity of problems that must be carefully considered before an installation is made. And so, along with the stoker and conveyor has grown a new profession—that of combustion engineer. Every important boiler plant is now designed by a combustion engineer to fit the peculiar conditions present. He considers the space available, value of the land, the kind of fuel available, boiler capacity, expected overloads, etc. The well-designed plant is a harmonious unit, through which the fuel passes without the expenditure of any manual labor and only the supervision of one or two trained men.

The result is not nearly so picturesque as the glaring furnace door and the half-stripped stoker, but it is much more efficient.

## Wood That Is Stronger Than Steel

(*Continued from page 204*)

by the laboratory experts; one made from the blood of animals and one derived from casein—obtained from milk. Panels were glued together with these and tested in boiling water for eight hours. At the expiration of this time none of the pieces showed any separation of the plies. Soaking in cold water for ten days gave the same results. Finally, tests with a shearing machine, which applied force in such manner as to push one ply from another, were made, and it was demonstrated that a pressure of from two hundred and fifty to seven hundred pounds to the square inch of glue surface was required to separate the layers, so strong were the new glues. As a matter of fact, it was, in most cases, not the glue, but the wood fibers themselves, that gave way.

In considering the application of this new water-proof glue and plywood to industry in our reconstruction period, it becomes evident that an entirely new field has opened for progressive manufacturers of wood articles. Who, till now, has put on the market a standard door that will not warp? Plywood panels cannot warp after they are finished, for one ply holds the next rigidly. What manufacturer has got out a table or chair with glued joints that will not fall to pieces in a damp atmosphere? Furniture made with casein glue will hold together far better.

SA

IN THIS ISSUE:

BUILDING IN THE WILDERNESS
SMOTHERING FIRE WITH BUBBLES OF GAS

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

WORKING WITH BARE HANDS ON LIVE LINES BY MEANS OF THE SAFETY STAGE—[See page 219]

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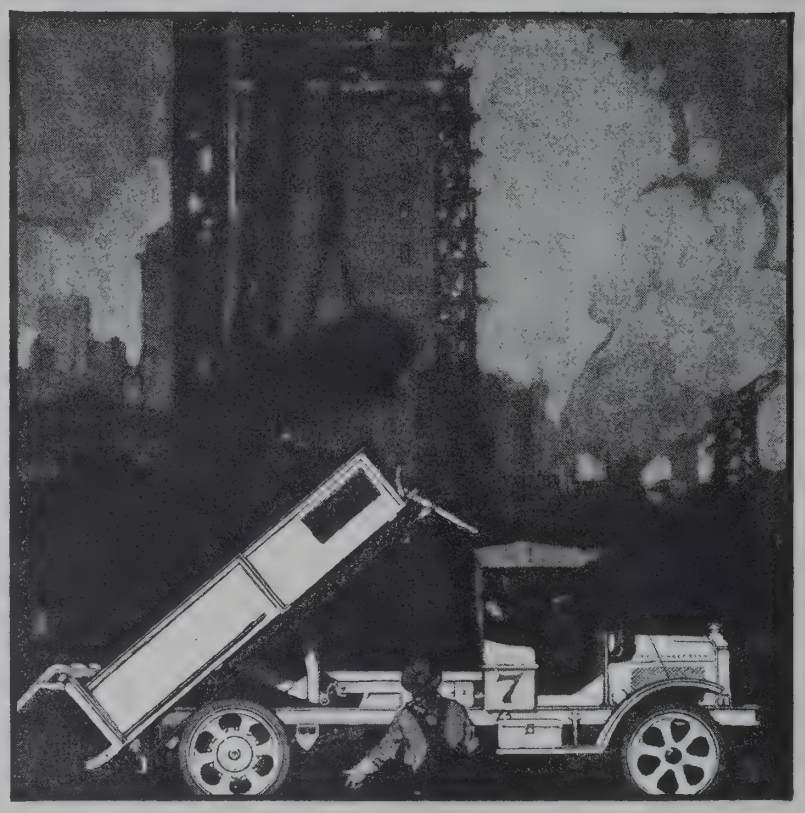

# FIRST *in* Construction Hauling

IN the whole field of truck operation there is no more drastic demand upon power, efficiency and endurance than in hauling crushed stone, sand, brick, cement, lumber, structural steel and machinery.

Tons of material are literally dumped into the trucks from buckets, chutes or derricks. These loads are carried over torn-up ground, into and out of excavations, to places where the trucks must break their own path. Materials must be kept moving. Deliveries are vital. Trucks work day and night.

For years White Trucks have had a predominant position in this field. They are the mainstay of contractors, of road and bridge builders, of dealers in lumber and building supplies.

They not only stand up and keep going day in and day out, year after year; they pay dividends long after the investment is written off the books. White Trucks are distinctly a balance sheet proposition; their earning power is *sustained.*

White Trucks are used by contractors in 156 cities. They are used by 431 lumber dealers; by 218 dealers in building supplies and by 224 miscellaneous concerns in the building and contracting field; 365 states, counties and municipalities use White Trucks on road construction and maintenance work.

These owners know from their cost records that White Trucks not only do the *most* work, but they do it for the *least* money.

THE WHITE COMPANY, *Cleveland*

# WHITE TRUCKS

# *A fire department you never heard of*

HERE it is—posing for its picture. No clanging bells or shrieking sirens. No red lined coats. Nothing spectacular.

Just a few skilled workmen—yet these men save the ladder and the engine crews many a trip by making roofs fire-safe with Asbestos. For the time to put out fires is before they start. And there is no better way to prevent roof communicated fires than by covering roofs with Asbestos.

Moreover, it is not only through fire protection that Asbestos makes roofs safe, but also through weatherproof durability. In fact, Asbestos seems ordained by nature to be a roofing material. This wonderful fibrous mineral is not only absolutely fire-proof, but in roofing form it is immune to the disintegrating effects of sun, snow, hail, ice, rain, smoke and acid fumes.

On the big flat roofs of industrial plants and other buildings you will find Johns-Manville roofers applying permanent fire prevention with Johns-Manville Asbestos Roofing.*

And on thousands of smaller buildings the owners themselves, or their employees, are doing the same. For the many different types of Johns-Manville Asbestos Roofing give everyone the opportunity to protect what is ordinarily the most defenseless part of his building—the roof—with one of these roofings.

*Asbestos Roll Roofing, Johns-Manville Standard and Colorblende Asbestos Shingles, Johns-Manville Asbestos Ready Roofing, Johns-Manville Corrugated Asbestos Roofing, Johns-Manville Built-Up Asbestos Roofings.*

*Johns-Manville Asbestos Roofings are approved by the Underwriters' Laboratories, Inc.*

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*And for the thousand and one types of modern buildings—including dwellings—Johns-Manville Asbestos Ready Roofings and Shingles are handled by dealers and dealer-contractors everywhere.*

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FIRE PREVENTION PRODUCTS

# JOHNS-MANVILLE
## Serves in Conservation


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# What makes engineering authority

VISIT the busy freight receiving platform of any railroad. Of the score or more motor trucks loading, there will be half a dozen assorted sizes doing practically the same work.

Why so many sizes for the same job? Which size is *right*? Who said so?

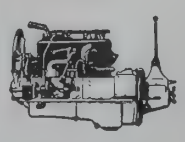
* * *

The business man can select his motor trucks either of two ways. He can trust to rule of thumb "commercial practice." Taking it for granted that the truck is right—that its parts are what they ought to be—and that his "saving" in first cost is a genuine economy.

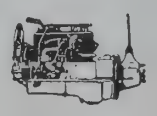
Or he can go straight to the truck vouched for by *engineering authority*. Designed for the work it has to do. Each part designed in relation to every other part—and built under rigid supervision. *Sure saving in cost of transportation.*

In all industrial America there is no higher example of engineering carried intensively into a product than the Packard Truck.

The 44 definite factors of superiority in the Packard Truck are the direct outcome of Packard intensive engineering.



Each size of Packard Truck designed for a specific transportation need.



Each size designed as a unit around its *engine* as a basis.

Rear-end, clutch, gears—each size the proper design for its own engine.

Packard unity of design overcoming that common difficulty—an engine too big for the rear-end, or driving mechanism too heavy for the engine.

One reason why Packard Trucks handle greater loads economically per hundred pounds of truck.

The design of the Truck—and of its parts. The selection of material. The new and advanced processes developed. Special machine equipment invented.

Packard standards in the finished truck ensured by holding one inspector responsible for the work of each twenty men throughout the Packard plant.

All leading up to the unequalled strength of the Packard truck parts and the high performance of the Packard Truck.

Packard engineering puts *economy on the road* ahead of cheapening production in the factory.

Low transportation costs shown by Packard Trucks—dependable performance—long life—all matters of record.

Records and the "44 factors" available to business men at local Packard headquarters.

*"Ask the Man Who Owns One"*

PACKARD MOTOR CAR COMPANY, *Detroit*

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

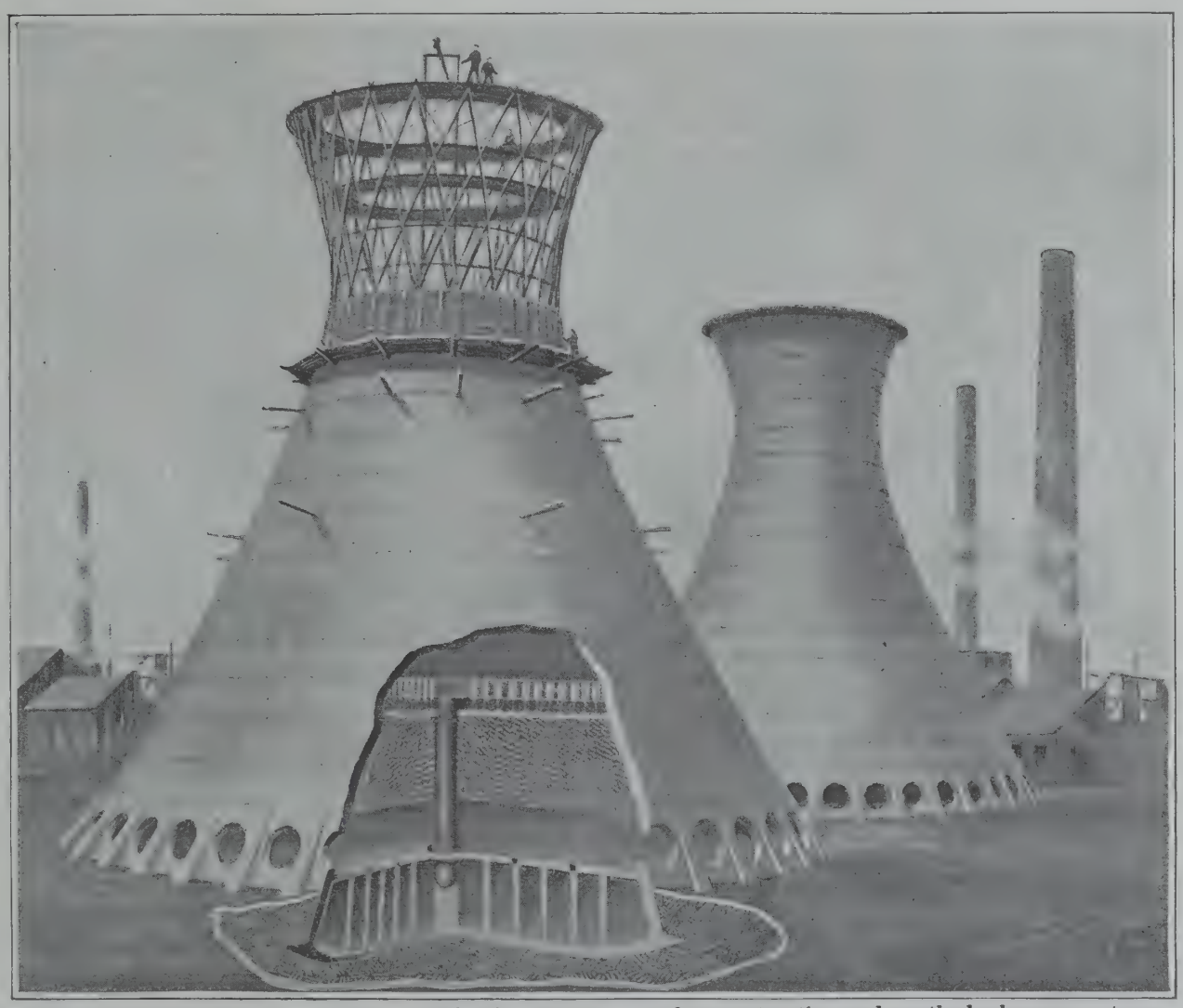
VOLUME CXXIII. NUMBER 10 ] NEW YORK, SEPTEMBER 4, 1920 [ 15 CENTS A COPY 20 CENTS IN CANADA

## Dutch Cooling Towers of Concrete

WHERE the electrical generating station is without an adequate supply of natural fresh cooling water, cooling towers, playing the same part in the station economy that the radiator plays in the operation of the automobile, are an essential. So vital to economical operation is successful cooling that a Dutch authority, writing in *The Electrician* (London) estimates that for every degree Fahrenheit drop in the temperature of the water ejected from the towers into the cooling system of the plant, steam consumption is reduced by one-third of one per cent. This makes it clear that the initial cost of cooling towers is a matter of small moment, since the attainment of high efficiency means that any cost likely to be incurred in construction will be regained through operating economies well within the life of the towers.

But notwithstanding long experience there is still a great difference in the efficiency of existing cooling towers, and the guarantees given by the builders are often not attained and are sometimes unattainable for physical reasons. A thorough investigation into the performance of a cooling tower is instructive, for faults are often detected, and in many cases improvements can be suggested. As the conservation of coal is of the utmost importance, in these days attention may well be given to this subject.

Our drawing shows the cooling towers at the central station of the Dutch State Collieries at Heerlen. Their construction and internal arrangement were the result of investigations made with several cooling towers of first class firms. The wooden laths are not drawn to scale, because their smallness would make them difficult to discern. This design of tower is an attempt to balance resistance to air flow and maximum cooling surface. The sketch shows how by a suitable arrangement of the lath the air passages were made as free as possible. The dry and wet bulb thermometers show that the air emerges almost saturated and sufficiently heated to cause a good draught. Many other cooling towers give too much resistance. The saturation with water-vapor and the heating of the air not immediately in touch with the falling water, are caused by diffusion and by the whirling of the air. The splashing water and the passages through the laths make it an easy matter to moisten and heat the air throughout. But it is very difficult to get an almost even temperature of the air on any spot above the timber hurdles.



**The latest cooling towers of concrete, showing one tower under construction and partly broken away to reveal the interior structure, and another completed**

As it was not possible to make the stream lines of air equal in length, uniformity in the conditions of the heated moist air over the whole surface of the cooling-stack was obtained by increasing the density of the spray from the center to the periphery. The radially placed gutters are slightly inclined, and the pitch of the spray nozzles is made smaller at the outer rings than at the middle rings.

The maximum cooling capacity is acquired only by adjusting carefully the dispersion of the sprinklers. Some inequality is unavoidable in heavy gales. But in this respect the cooling tower of circular section behaved well enough, and it was found that with large towers the best results were obtained when the radial screens, which as first designed divided the tower into sections, were removed. A cooling tower requires frequent and regular supervision. This must be effected by means of the dry and wet bulb thermometer. A water softener of ample dimensions must be installed when only hard water is available, and the collecting tank must be emptied and the water renewed at least once a year. The lath work of many cooling towers has collapsed through becoming covered with deposit.

A cooling tower is an hydraulic apparatus, and therefore it cannot be much overloaded. The cooling towers described in this article are each rated 6,000 kw., or 550,000 gallons per hour. The gutters are normally filled to about two-thirds of their depth, and as the water level rises with the square of the discharge through the nozzles the cooling tower can only be overloaded 25 per cent before the gutters overflow. The maximum capacity of the tower represented is about 700,000 gallons per hour. It is quite possible to overcharge a cooling tower much more than this, but the overflowing of the gutters is very bad for the efficiency.

As wooden cooling towers have a lifetime of only 15 years, and even in this space of time require many repairs, and as the initial costs and the expenditure on the upkeep of steel towers are prohibitive, the only material appropriate for cooling towers is reinforced concrete. The cooling towers represented in the illustration are constructed on the principle of an eggshell. Instead of supporting the dead weight and providing for resistance against the pressure of the wind by means of separate supports on the outside or the inside of the walls, or by beams, buttresses or other reinforcements, the wall is of double curvature, which withstands the pressure of the wind and supports the dead-weight by itself. The reinforcing rods are placed according to the straight describing lines of the hyperboloid and therefore require no bending. The construction although built with a minimum of material is of unexpected rigidity and strength, and therefore hardly more expensive than a wooden tower of about the same principal dimensions.

## New Plant Foods

DURING a recent meeting of editors of agricultural journals, held in Washington, the Department of Agriculture placed on exhibition specimens of edible plants which the department has introduced into this country and which have now passed from the experimental stage of culture to a permanent position among American crops. The fruits and vegetables exhibited, all of them grown in the United States at Government stations, included cassava root, dasheen tubers, udo shoots, passion fruit, white sapote fruit, chayotes, and a number of highly colored and extremely fragrant varieties of mango. A majority of these plants can be grown only in the South, but should make their way into northern and western markets. The department states that the udo, a celery-like shoot from Japan, is now grown successfully as far north as Nova Scotia. It is a salad vegetable, quite novel in taste and texture to Americans. The Department's activities in extending the range of crops must in the long run be of extreme value.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## How Many Miles to the Gallon?

WITH the gasoline situation that exists today, it is surely not too much to ask that every driver, if not for his own sake then for that of others, take all reasonable precautions to bring his gasoline mileage up to par, or even a little above par. The question of the operating economy as it affects the pocket-book of the individual owner in many cases seems an object hardly worth striving for. But quite aside from this is the effect on the general situation. It seems no remote cry to the day of gasoline rationing, when each car-owner may be told that he can have just so much gas and no more—that day has already found temporary place in the California calendar. Alike as a matter of valuable practice against the possible day of rationing, and as a means of postponing that day, everybody ought to seek the summit of gasoline mileage for his car.

Without disfiguring this page with unprovable assumptions and dry arithmetic, it can be calculated on an eminently reasonable basis that if every driver increased his mileage by a mere ten per cent, there would be enough gasoline saved to run about two-thirds of a million cars throughout the year. Twenty-five or fifty or even a hundred gallons unnecessarily burned in the course of a year by the individual driver is not going to make or break anybody, even at forty or fifty cents a gallon; but gas enough for two-thirds of a million cars might well make or break the automobiling community. That the good performance cuts the gasoline bill is immaterial—what we are driving at is to cut the demand for gasoline. There are many ways in which intelligent operation can do this. The thing is largely in the hands of the man who handles the throttle and the pedals. Most motors carry an unnecessary load somewhere. Brakes that drag, as shown by their being hot after the car is allowed to coast to a standstill; a motor so stiff that it will not rock freely when cranked by hand with a close throttle; undue friction in the running gear as shown by a car that is hard to push—all these things consume power, and have been known to raise gasoline consumption nearly one hundred per cent.

Then there is scope for much care in keeping the motor in good operating condition. Leaks past the piston or leaky valves allow a respectable fraction of the power to escape. A cylinder that does not fire wastes one-twelfth of the gas in a twelve; it wastes one-quarter of the gas in a four. Loose joints in the complicated series of connections that lead from the piston to the rear wheels do not waste power in such large blocks, but they waste it, be sure of that.

Carburetor adjustment is something of which many drivers know next to nothing. It is true that an over-rich mixture gives better acceleration, but at a ruinous price, not merely in the direct consumption of fuel but indirectly through the deteriorating effect on the engine. It is unfortunate that a rich mixture must be used for starting and until the motor warms up; but do not make the carburetor adjustment permanently rich to take care of this. You are given a carburetor dash control to cover this very ground; use it. Make an economical adjustment of the needle valve with the engine warm; get the temporary rich mixture with the dash control.

Do everything possible to keep the motor warm while in use. The gasoline of the day will not vaporize into an explosive mixture unless the intake manifold is hot, and everything that contributes to this condition will help fuel economy.

A final point that escapes many drivers is the effect of unnecessary speed variation. We would not be interpreted as advocating reckless driving, but the fact is that every time you slow down with the expectation of speeding up again you are laying up a debt to the laws of motion which you must pay by burning gas. Acceleration burns up gas, deceleration means failure to get the most out of the gas you are burning during the period for which it lasts. So drive at a uniform speed, so far as feasible.

## Wanted—A Proverb

SINCE our publication of the details of the Michelson-Morley experiment, we have had a number of communications from our readers, asserting in more or less positive terms that this experiment proves nothing. The argument runs about like this:

Suppose a swimmer or a rower make a return trip upstream and down, contending with the current as he goes up and getting its benefit when he comes down. Obviously, says the self-appointed critic, since the two legs of the journey are equal, he derives exactly as much benefit from the current when he goes with it as he suffers handicap from it when he goes against it. So the round trip must take exactly the same time as a journey of the same length in still water, the argument applying equally in the case where the "swimmer" is a wave of light in the ether stream.

It seems extraordinary that so many people able to take an interest in the Michelson-Morley experiment and the Einstein theories should be ignorant of the fundamental principle here involved. We had at first doubted that this was a subject worthy of discussion on this page, but the extent of the misapprehension has resolved this doubt. So let us look at a numerical example.

A man can row in still water at four miles per hour. He rows twelve miles upstream and back, in a current of two miles per hour. At a net speed of two miles per hour he arrives at his turning point in six hours. At a net speed of six miles per hour he makes the downstream leg in two hours. The elapsed time for the journey is eight hours; in still water he would row the twenty-four miles in six hours.

If we were to attempt an explanation of this result in words we should say that by virtue of the very fact that it does delay him, the adverse current prolongs the time during which it operates; while by virtue of the very fact that it accelerates his progress, the favoring current shortens its venue. The careless observer realizes that distances are equal between the two legs of the journey, and assumes that times are equal.

If the journey be made directly with and directly against the stream of water or ether or what not, retardation is effected to its fullest extent. If the course be a diagonal one, retardation is felt to an extent measurable as a component, and depending for its exact value upon the exact angle of the path. Felt, however, it must always be.

The primary purpose of this editorial, of course, is not to correct this misunderstanding—greatly as it may call for correction. Those who have been in ignorance of the phenomenon just demonstrated necessarily lack any knowledge of algebra, since we are acquainted with no text in the elements of that subject which does not contain problems revolving about swimmers and rowers, or in late years aviators flying with and against the wind—problems which involve this principle and which cannot be solved without its application.

With the man who asks us to explain the Michelson-Morley experiment to him, because so far as he can see it is incapable of giving a positive result under any conditions, we have all the patience which his desire for enlightenment demands. We should think he might improvise a numerical case that would enlighten him, but if he can't or won't we are quite ready to do it for him. But with the man who from the depths of his ignorance calmly informs us that the Michelson-Morley experiment is foolish, that the eminent scientists who originated it and those who have repeated it after them and those who have used it as the basis of their theories and their teachings are simple-minded—that the whole world of science is chasing a shadow—well, when this happens we feel the inadequacy of the proverb about fools and angels.

Will not someone present us with a brand new pearl of wisdom to cover this ground?

## The Psychology of the "Rider"

AT a point which we shall not try to localize in the development of our governmental procedure, the astute gentlemen whom we are in the habit of sending to represent us in the legislative halls made a scientific discovery of great importance—to them. Reduced to its simplest terms, this is it: If you have a piece of legislation which you know is vicious or predatory or in any way questionable to the extent that its passage on its merits seems difficult, hook it on to some general bill of importance in the form of a "rider." It will then in all probability come through with flying colors.

That the general bill thus utilized has nothing to do with the subject of the rider is understood. That the practice of thus jamming through legislation which shrinks from scrutiny is reprehensible will not be questioned. That this practice is on the wane we think will be admitted, in spite of recent riders which have attracted wide attention. But in any event, our interest here is with another point.

It would seem a reflection upon legislative intelligence to assert baldly that a measure which could not pass on its merits could be passed if tucked away in the bowels of the general appropriation bill. Yet experience has shown this to be a fact. Why?

Doubtless the reason is a complex of numerous legislative emotions and desires. In the first place, there will be members who want to vote for the measure which is thus disguised, but who are not sure that their constituents will stand for it. These men feel, and experience justifies them in this, that their vote on the general bill will not stand as a specific record of their attitude on the question of the rider, a record which may rise to harass them during the period immediately preceding the first Tuesday after the first Monday in November. To an extent this is a reflection upon their constituents; to this extent their constituents have earned such a reflection. But the constituent may be excused if he takes the attitude which probably accounts for the greatest number of votes in the legislative body itself.

There is always a good number of members who have steered a general bill through the perils of committee and floor. Their efforts are not centered during this struggle in keeping the bill intact or free of extraneous matter—they are well pleased if they can preserve enough of its original form to be recognizable. And when it finally sees the light of the open house and comes to vote, they and many others swallow the rider, fearing that if they did not do this the main bill might not fare so well in its essential features on going through the mill a second time. Few legislators indeed will sacrifice what they want for something that they don't want; and on the whole the constituency is of the same mind.

We must not forget, either, that the support of a rider comes always from those who are actively and materially interested in its passage; while the opposition usually is a matter of principle, and far less vigorously prosecuted. Then on a close line-up over the big bill, the votes of the supporters of two or three riders might make all the difference between passage and rejection.

The committee system affords another reason for introducing legislation in the form of a rider. The committee to which a general bill goes may have the necessary majority to report the rider, where the committee to which the minor measure would go if introduced as a separate bill lacks that majority. And if the rider is really vicious but looks innocent on the surface, it is less likely at the hands of the busy general committee to get a thorough discussion that will expose it. So when we have considered all the possibilities, it turns out not to be at all surprising that riders succeed where special bills fail; and the fact that today riders get more and more pitiless publicity, that more and more often they fail, is really an indication of considerable advance.

## Electricity

**Our Radio Stations** are steadily growing in number. According to *The Wireless Age*, the Government shore radio stations number 135 of which 88 are in continental United States, 20 in Alaska, 19 in the Philippines, 3 in the Canal Zone, 2 in Hawaii, and one each in Porto Rico, Guam and Samoa. The Government ship stations total 470.

**Wireless Research in India.**—Upon completion of the research work, which is being done in India by a staff of scientists in order to find means of overcoming the meteorological obstacles which interfere with the proper working of wireless telegraphy in India during certain seasons of the year, there will be a great extension of the wireless system in that country.

**Combined Ceiling and Reading Light.**—An ornamental lighting fixture with a center light that may be pulled down close to a table for use as a reading lamp has been developed by a Western concern. Ordinarily the fixture has the appearance of the common four-light fixture, but the center lamp has a flexible cord wound on a reel in the fixture which unwinds when the lamp is pulled down.

**The Use of Induction Motors.**—The fusing of an alternating current motor should be determined by the normal running current, and should be regulated by the starting fuse, if such fuse does not exceed the normal running current by a certain specified amount, this value to be somewhat below the maximum current at which such motor may operate for an indefinite time; and it is also regulated by overload releases, and by time-limit circuit-breakers. The wiring and the fusing are separate problems.

**Night Landing by Means of Radio.**—Wireless calls for aid sent out by a Government mail plane which faced a descent in the dark, enabled the plane to make a safe landing, according to *Wireless Age*. Delayed an hour by a wind storm on the last lap of a journey from New York to Chicago, the radio operator on the plane sent out calls while approaching Chicago to light the landing field and prepare for the machine's descent. The message was picked up by the wireless operator at Great Lakes Naval Training Station and on several amateur wireless outfits and relayed to the landing field by telephone. The plane, which carried three passengers and 1,200 pounds of mail, landed at eight o'clock.

**High Speed Wireless.**—Manual operation is doomed as far as long-distance radio traffic is concerned. The ever-increasing cost of high-powered stations makes it necessary to handle a far greater volume of traffic than can be handled by the usual method. Thus some of the present transatlantic stations are operating at 50 words to 100 words per minute by means of automatic transmitters and receivers. In England experiments have been going on for some time with automatic transmitters capable of a normal speed of 450 words per minute, and even 1,000 words per minute during demonstrations. The recording is effected by means of a special electro-chemical apparatus. This apparatus consists of a specially prepared paper drawn between a roller and a marking pointer. The arrival of a signal causes a current to pass through the paper, producing discoloration.

**Elimination of Insulator Failures.**—In a recent issue of *Electrical World*, Mr. E. J. Kallevang describes methods of detecting faulty insulators, and notes the fact that insulators that have been stored several years are found to have deteriorated. This deterioration may be due to mechanical stresses or to the electrical test that has been applied at the works. It is observed that insulators near railway tracks break down readily. This is supposed to be due to sulfur fumes, which may attack the cement and promote crystallization. It is also suggested that in such cases the insulators may reach higher temperatures due to their blackened surfaces. Methods of testing by the oscillator or by the megger are described. It is believed that the higher percentage of failures in the top unit in suspension strings is due to the fact that it is subject to more abrupt changes in temperature. Trees which are near the line, or overhang it, are a frequent source of damage.

## Science

**The International Research Council.**—A report of the proceedings of the first meeting of the International Research Council, held in Brussels in July, 1919, has been edited by the secretary, Sir Arthur Schuster, and published in London by Messrs. Harrison & Sons.

**Thefts of Platinum.**—It is said that organized thefts of platinum are taking place throughout the United States. The matter has become so serious that, at the suggestion of Dr. W. F. Hillebrand, the American Chemical Society has appointed a committee to consider whether legislation may not be recommended to Congress with a view to dealing with the situation.

**The Norwegian Geophysical Commission.**—A new body known as the Geofysiske Kommission represents a union of Norwegian institutions and explorers in the domain of hydrography, terrestrial magnetism and the study of the aurora borealis. With the aid of funds granted by the Norwegian Government the commission has begun publishing a series of memoirs, *Geofysiske Publikationer*, in English, French and German.

**Recent Surveys in Spitsbergen.**—A systematic survey of Spitsbergen has been carried out annually by the Norwegians since 1906. During the year 1919 a party of surveyors, hydrographers and geologists, headed by Adolf Hoel, mapped a total area of about 520 square miles, and made hydrographic surveys over an area of about 1,620 square miles. A chart recently published by the Norwegian Hydrographic Office, of the Arctic Ocean from Norway to Spitsbergen, embodies the results of the hydrographic surveys of the Spitsbergen coasts down to 1918.

**Weather Forecasts by Wireless Telephone.**—The distribution of weather reports and forecasts by radiotelegraphy has made great progress since the war, and is no longer intended primarily for the benefit of mariners. The wireless telephone also has recently been pressed into the service of meteorologists. Arrangements have now been made so that the weather forecast sent out by this method every day at 10 A. M. from the Physics Department of the University of Wisconsin can be received, with suitable apparatus, anywhere in southern Wisconsin. A U. S. Weather Bureau station is located at the university.

**Anthropology of Polynesia.**—Dr. Henry Fairfield Osborn has recently called attention to the urgent scientific reasons that exist for immediately taking up an energetic and systematic study of the anthropology of Polynesia; one of the undertakings that will, it is hoped, be set on foot by the forthcoming conference in Honolulu on the problems of the Pacific. Dr. Osborn states that the material for such an investigation is disappearing with almost incredible rapidity. The ravages of influenza during the past two years have swept away a large part of the members of the Polynesian race. The survivors on certain islands constitute a very small percentage of the original population. Researches on the physical anthropology of the Hawaiian group have recently been begun as a cooperative enterprise of the Bishop Museum of Honolulu and the American Museum of Natural History of New York.

**Fungi That Damage Canvas.**—Major W. Broughton-Alcock of the British Army has made some studies on the fungi that cause black and brown spots on canvas tents, awnings, etc., and that bring about a more or less rapid destruction of such articles. A note on the subject by J. Ramsbottom appears in *Nature*. The investigations were carried out partly in Malta, where, it is said, awnings last only about a year. The principal destructive agents in the case of cotton- and flax-made canvas were found to be *Macrosporium* and *Stemphylium*. The variation in the color of the spots is found to be due to the presence of various other fungi in association with the genera above mentioned. The first signs of fungoid growth appear on the inner side of the roof portions of tents and marquees. Often within three months pressure on the spots made by the fungi leads to perforation, or a strong wind causes tearing. Experiments showed that the Willesden (cuprammonium) method and cutch treatment prevented the growth of the fungi.

## Automobile

**Motor Farming Suits Italy.**—Italy has disposed of about all of the 6,500 farm tractors bought from the United States in 1917 and of a number purchased locally. In the meanwhile Italian farmers have learned the benefit of motor cultivation and will naturally continue to use these implements in large quantities. In 11 months of 1919 that country imported 8,114 metric tons of reapers, mowers, tractors and other farm machinery.

**British Motor Tax Based on Road Wear.**—The new taxes which it is contemplated, will be levied on motor vehicles in the United Kingdom, will be based on the amount of road wear, according to a statement of the Ministry of Transport. The horse-power will be the unit for the calculation of the tax on private motor vehicles, their weight the unit for commercial vehicles, and the seating capacity for hackney carriages and omnibuses. Motorcycles will be taxed on their weight with an added amount for sidecar or trailer.

**A Windshield Compound.**—Among recent automobile novelties is a liquid which is easily applied to a wet or dry windshield with cloth, sponge or tissue paper. The manufacturers claim that one application will keep the glass clear for 12 to 24 hours, through the most severe storm of rain or snow—no matter how hard the rain, hail or snow beats, it will not stick. The advantage of this over the more usual methods of keeping the shield clear is that one does not have to remove one hand from the wheel while driving. The makers emphasize that the substance is not a grease or a soap, but a chemical compound quite different from either of these classes.

**New German Self-Starter.**—A description of a German self-starter which is in reality a device for filling the firing cylinder with a strong mixture so as to permit of a starting on the switch—for use with the Bosch self-starting coil—has appeared in a recent issue of a German automobile paper. A supplementary jet is attached to the carburetor, and gas is drawn by means of a hand-pump and forced through a small chain-driven distributor to the required cylinder. The fixture for the cylinders consists of a Y adapter, one arm containing a non-return valve through which the gas is forced, and the other arm containing the sparking plug. The advantage claimed by this device is that it can be fitted to almost any existing motor at very little expense.

**Easily Located Carburetor Troubles.**—When an automobile engine, after starting, runs for a minute or two and stops, the first place to look for the trouble is the gasoline feed line. A partial stoppage in the fuel supply pipe will lessen the flow of fuel so that the float chamber fills slowly. On being started, the engine will quickly consume the gasoline in the chamber and stop. Another possible cause for the fault is the float sticking, and if the float sticks in the high position the flow of fuel will be greatly lessened or may be stopped entirely. Water in the gasoline is also troublesome as a drop may get into the feed pipe or the spray nozzle and interfere with prompt starting or reliable feed of fuel. Lint or other foreign matter around the filter screen in the feed line is also responsible for restricting the fuel flow, especially in cars using the gravity feed system.

**One Truck Hauls More Than Seven Teams in Road Contracting.**—An interesting comparison has been made in a recent number of the *Oklahoma Highway Bulletin* with regard to teams versus motor trucks in the hauling of road building materials. A road contractor while doing state aid road work of hauling crushed stone, employed seven teams, seven drivers and one 3½-ton motor truck. The seven teams had each hauled three loads of 1½ yards per day, a total of 4½ yards daily. By motor truck he hauled 33 yards each day. Figuring the cost of each team and driver at $7.25, the total amount was $50.75 per day for seven teams. The 3½-ton motor truck actually hauled more material each day than the seven teams. The operating expenses of the motor truck figured to $18.40 per day, thereby effecting a daily saving of $32.35. The distance of the haul was 4½ miles each way, or a total of 9 miles.

The yards of the Hetch Hetchy Railroad at Groveland

Full train of locomotive, flats, gondola, box-car and caboose

# Building in the Wilderness

## Where the Engineer Has to Lay Down a Railroad to Take Him to His Job

By A. R. Surface

THREE hundred thousand tons of construction material is the amount estimated as necessary for the Hetch Hetchy Dam and other work connected with the Hetch Hetchy water supply enterprise of San Francisco. A large part of this must be carried far into the foot hills east of the city—far enough in fact to attain an elevation of some 3,500 feet above the sea in a valley location. The great dam, the principal item of the whole work, is to be located there in the Sierra Nevada many miles from the nearest ordinary railroad. The intervening country is very difficult to traverse; so that one of the serious problems that had to be faced was how to get the enormous tonnage from an existing railway to the points of use notwithstanding the difficulty of the topography. Naturally, there were two alternatives—a road adapted to heavy motor trucks and tractors, or a railroad. The second was the one chosen. The location survey was completed just about five years ago.

It may surprise some that it was decided to build a railway rather than an ordinary road. It is a matter of calculation. The report of the chief engineer, Mr. M. M. O'Shaughnessy, five years ago was to the effect that 233,000 tons of equipment and material would call for transportation. It was estimated that the cost of hauling by motor truck would amount to $3,095,000 and that the expense by the railroad method would be only $2,010,000. From the point of view of the water-supply project alone, a saving of $1,085,000 would be effected by the railroad. Apparently, the amount of material estimated as necessary has considerably increased since that early date; so that the saving is to be set higher yet. In addition, the transportation is to be viewed as rather likely to be more rapid with the railroad. Further, such a road would earn something from outside freight and from passenger service, and would remain at the end a very considerable asset. However, there is a point which needs to be added. At the time of the estimate it was considered necessary to use double sacks with the cement when transported by motor wagons. As a very large percentage of the total freight would consist of cement, the extra expense of 11 cents per unit constituted a heavy debit against the motor truck. The estimated cost of the railroad seems to have been considerably in excess of the actual expense, as the contract was let for $1,543,080.74.

The Hetch Hetchy Railroad connects the site of the great dam with the immediate vicinity of Rosasco which is a station on the Sierra Railway of California. Between the two terminals, Hetch Hetchy Junction and Damsite, are 68 miles of standard-gage track. Here is a very considerable little railroad, built primarily as a means of constructing something else. Doubtless, the road will be maintained after all construction work on the great project is completely finished. This construction railway is a real railroad and not a pretense nor a freak. There is no grade amounting to more than 4 per cent but the curves are sharp.

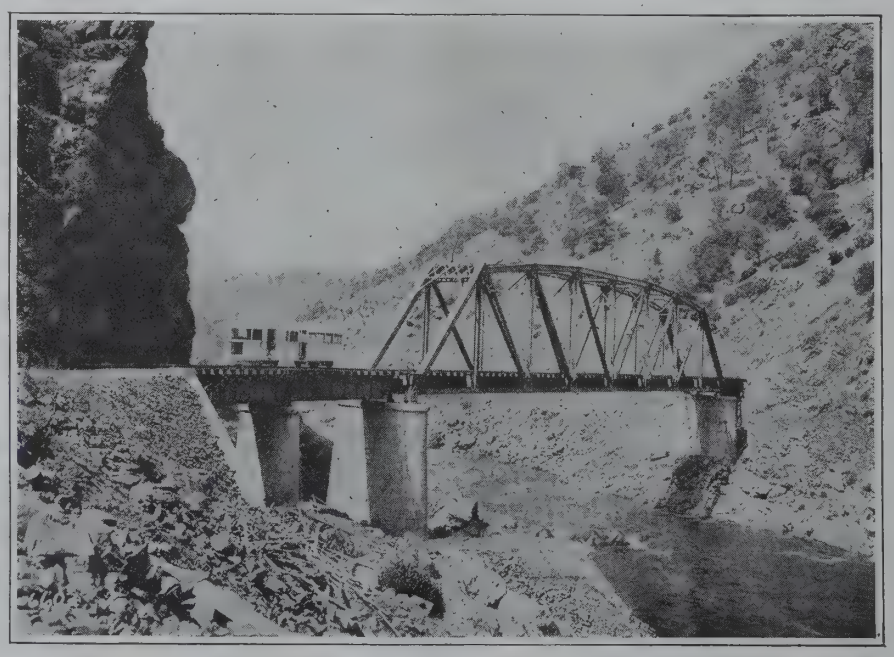
The general direction of the road is east and west, though naturally it winds about in order to take advantage of topographic features. At the Junction the elevation above the sea is 935 feet, but the line drops to 625 feet soon after leaving this terminus. This drop is made in the course of but 9 miles of track and has of course to be later on recovered. The object in view was to get across the Tuolumne River, the very stream which in fact forms the foundation of the water supply project. This river is subject to floods, but the bridge carries the track over at 12 feet above high water. Once on the other side of the stream, the railroad naturally stays in the valley; but it does not always cling to the river itself. In order to get uphill and downhill without excessively steep grades and without heavy expenditures on construction, it was found necessary to use sharp curves and plenty of them. The gentlest curvature round bends is 30 degrees while there are numerous curves in the range 18-26 degrees. The curves if put together and arranged in one circular direction would yield nearly 100 complete circles. The most considerable elevation attained is 5,064 feet at Poopenaut Pass. This is a good deal higher than any regular railroad attains in passing over the Appalachians in the eastern United States. The road is 50 miles long from where it crosses the Tuolumne until it reaches this highest point, so that the 4,439 feet of difference in level is attained at the average rate of about 88¾ feet per mile. On the western side of the pass the descent is pretty steady on heavy grades until Damsite is reached, where the elevation is 3,869 feet above the sea. The drop of nearly 1,500 feet is accomplished in 9 miles, or at the average rate of about 166 feet to the mile.

This road in the mountains had to cut its way largely through real rock. Of the 1,000,000 cubic yards of excavation more than half was in rock. Naturally, there are many ravines, little valleys and little canyons that are crossed. In general, timber trestles and the like were employed. Some 500,000 board-feet or more were consumed in this work.

The subgrade of the roadbed is, for the 59 miles from the Junction to the summit of the Pass, 16 feet in width. For the remaining 9 miles from Hog Ranch down to Damsite in Hetch Hetchy Valley, the width is 6 feet greater. When the railroad is no longer needed for the work at the eastern end, the track will be taken up and the roadbed resurfaced. There will be then left a fine road for automobiles.

Many of my readers will ride over this nine-mile stretch despite the fact that it is now occupied by railroad rails, cross-ties and ballast, for already the Yosemite Park Company is operating tours from Yosemite to Damsite. An ordinary motor bus brings the tourists to Hog Ranch—or, Mather as it is now more aesthetically termed—by travel over a route 35 miles long. From Mather down to Damsite, the conveyance is a special motor bus which runs on the railway track.

With a view to facilitating the work at the Hetch Hetchy Dam and of providing a means of turning trains, a loop has been added to the railroad at the eastern terminus.



A typical bridge along the line of the Hetch Hetchy road

## Use of Rare Sugars as Medicine

THE so-called rare sugars are used to a considerable extent by the Medical Corps of the Army, and by the profession in general. One of the principal uses to which they are put is the differentiation of bacteria, for which purpose they are invaluable. For some time the Bureau of Standards has had presented to it for test a number of these rare sugars. Owing to the large demand for one of these sugars, known as d-Mannite, the Bureau has undertaken, at the request of the War Department, the production of a considerable quantity of this substance. The Bureau's investigation has finally developed a method whereby pure white crystals of d-Mannite can be produced by two crystallizations from the crude manna.

## The Third Degree for the Baseball

**By Edgar Lockhart**

WITHOUT baseball lots of Jacks in America would be mighty dull lads. Without the National pastime, countless thousands of fans who now gain recreation and pleasure in watching "Babe" Ruth, "Ty" Cobb and other veterans of the diamond in their base-stealing or fence-busting specialties would be glum and disconsolate. Without this typically American sport our athletic initiative would be jeopardized. Baseball is our invention, our possession and one of our most fruitful resources for demonstrating to the world our athletic supremacy. And every American youth at one time or another does his best to sustain the prestige in which the great game is generally held.

A baseball for service and maximum utility must be adapted to withstand the shock of batting and at the same time must possess sufficient resiliency and buoyancy for flight and catching in the hands of the different players. The American baseball preëminently is a development from the English cricket ball. The English originally used a rubber composition ball and later a ball having a central core with a resilient layer or cover on the exterior. Finally a solid cored ball surrounded by filamentous windings was devised.

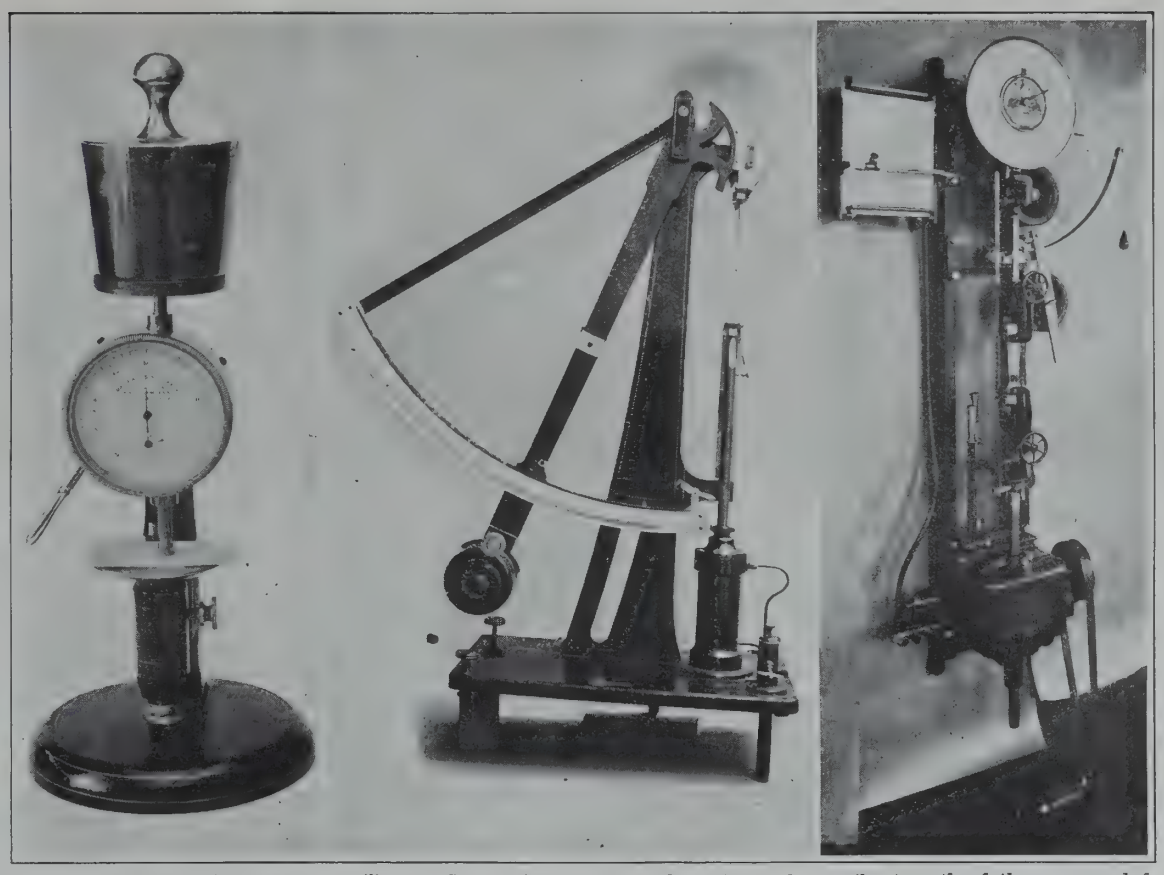
The next step in the ball line developed by ambitious inventors was the initial baseball which consisted of yarn wound on a resilient core and encased in a leather cover. H. A. Alden, Mattewan, N. Y., on December 17, 1867, was granted the first patent rights on a baseball which consisted of a composite of rubber, lead and cork with sulfur used to vulcanize the compound. Under practical service, this type of ball proved unsatisfactory with the consequence that its originator the following year turned out another model ball made of ground cork encased with cord windings and surrounded with a rubber compound cover. Later this ball—which proved fairly serviceable—was improved by the substitution of a leather for a rubber cover.

In the early history of the game freak balls were numerous, the prize innovation of this description being a ball with a bell as a core which rang when the ball was batted. This ball was invented about 45 years ago. Otherwise than as an asset to keep the players from going to sleep, this comedy baseball possessed no merit. However about the same period, patents which subsequently proved valuable were taken out featuring the use of a square reefing knot and the herring-bone stitch.

In 1883 B. F. Shibe devised the use of a plastic cement and an india rubber solution for holding together the core of the ball and the yarn wound upon it. This arrangement permitted the cover to slip on the ball when batted without in any respect damaging the interior. One of the latest inventions of Mr. Shibe—perfected during the last decade—gives to the best baseballs increased uniformity and rigidity of structure. He uses a central cork core and winds around it a layer of yarn and rubber, vulcanizing this to the desired degree of hardness and resiliency. Such a core permits of winding the yarn very tight and hence results in a better and more durable ball.

Horsehides imported largely from England and Russia—although during the war domestic baseball manufacturers had to depend largely on native supplies of skins—are used for baseball covers as well as for patent leather, uppers for shoes, thongs for whips and for sewing harness. Horsehides are tough, durable, wear well under rough usage and are capable of with-

(Continued on page 233)



*Left:* The instrument that measures resiliency. *Center:* Apparatus for determining the tensile strength of the yarn used for stitching or winding. *Right:* Machine that tests the force necessary to rip the stitches out of the ball—something quite different from straight tensile strength

**How the Bureau of Standards separates the sheep from the goats of baseball manufacture**

## Handling High Voltage with Bare Hands

**By George Gaulois**

FOR many years there has been no startling improvement in the method of working high voltage lines. Year by year there has been a constant tendency toward increased voltages. The quality of line materials has kept pace with the requirements of up-to-date line construction, but little thought has been given by the electrical fraternity to the urgent need of better and safer equipment for maintaining the line in a high state of efficiency.

It has remained for an American engineer to introduce a new method of working on high voltage circuits, which makes it unnecessary to shut off the power for protracted periods with the resultant inconvenience to electric power users. This method consists of putting the protecting insulation not between the man and the line, as has been done in previous efforts to attain the desired result, but between the man and the ground, thus eliminating the cumbersome, long-handled insulated tools which have heretofore been used on live wire work. The problem has been one of securing the proper insulation, and this problem has been solved in the safety staging which is shown in the accompanying illustration, and which forms the cover subject of this issue.

The safety staging, made of carefully selected hard wood submitted to a special drying and impregnating process, has been on the market for some time. It is only recently, however, that this treatment has been perfected to a point where the designer has felt justified in eliminating all insulated tools and allowing the men to work direct on the live line with bare hands. With this staging properly placed, which is but the matter of a few minutes, the man enters it and by so doing interposes between himself and the pole (or steel tower) an insulating medium capable of withstanding over one hundred thousand volts. Guards are so placed as to prevent any possibility of accidental contact with a grounded arm, guy wire or another phase of the circuit.

The man working on the safety staging is free to touch the live wire at any time. In grasping the line there is no discomfort whatever to the man, although there is a slight "pip" similar to a static discharge.

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**Left: High-voltage crew with complete safety staging outfits for working on live high-voltage lines. Right: Placing the safety staging preparatory to changing a string of disk insulators on a 33,000-volt live wire**

# Muggy Days and Thirsty Air

## The Mechanism That Keeps Us Cool, and Why It Fails to Work in Damp Weather

By Professor Alexander McAdie

IN the SCIENTIFIC AMERICAN for May 29, 1920, a leading editorial of rare literary charm describes the paramount importance of water. We are shown how all modern engineering depends in the last analysis upon the successful handling of some water problem; and that "by far the greater portion of the human struggle for collective existence hinges on the control of water, keeping it out of the places where it is not wanted and insuring its presence in those locations where it is desired." It is free to flow, it freezes, it melts, it fetches and carries; it is at times the most docile of servants and again it breaks all bounds and spreads destruction far and wide.

There is just one other substance that is as important to man's welfare, and that is *air*. Man quite early in his career attempted with success the mastery of water; but not until our own day have engineers been called upon to master air. They now put it to work, and in the pages of the SCIENTIFIC AMERICAN one can read of many practical applications: carrying heavy bricks, as well as light cotton; sucking coal from the bunkers on the destroyers; cooling the wireless spark; revitalizing the air in engine rooms; ventilating the kitchen; operating the laundry; under pressure digging a way beneath river or through rock bed.

Geologists tell us that in arid regions the erosive power of the wind, that is, the unharnessed sand laden air, changes the face of nature more than the washing rains; and that the action of air is more extensive and persistent than the action of water. What then of the combined effects of water and air upon those who walk the earth and breathe the air? Here is a problem in human engineering; and a problem that concerns us all as no other ever can.

### The Water in the Air

Air carries water in the form of vapor, as well as in the liquid or solid form. And so while it has been customary to speak of the *capacity* of air for vapor, and in a way we might describe this condition as air *thirst*, we of course realize that the air itself has no real capacity for vapor, and that the quantity of vapor present is not a measure of any physical property of air any more than a quantity of air in water would be an essential part of the water. Like man and wife, air and water vapor pass as one, and in many problems we deal with the combination or mixture; nevertheless each is an entirety, each has its own characteristics. But it makes a vast difference in our feeling of comfort whether the load of vapor which the air carries be light or heavy and whether the temperature at the time be high or low.

There are days, muggy days we call them, when no one is comfortable. Even the best natured of our friends are uneasy; if not indeed fretful. We are all irritable and we know not why. On another day, things are different and we regret and wonder at our crossness. Oh, for the engineer that will regulate, not indeed the weather, but the essence of all weather, the load of water vapor which the air carries. Then all of our days will be days of maximum comfort and minimum irritability. John Hay wrote of such days, calling them Castilian days, days of quiet charm and perfect rest; and probably he was entirely unaware of the fact that with a heavier load of water vapor and higher temperature those same days would have been transformed into the trying, muggy hours of our mid-summer climate.

One Castilian type of day occurred on Easter, April 8, 1917. The relative humidity at Blue Hill Observatory went down to 2 per cent. In the records for 35 years we have not found so dry a day. Possibly it was the driest day in a century. Some rather precise measurements showed that in every five cubic meters of space there was only one gram of water vapor, when ordinarily there would be one hundred grams. The weight of water vapor present is not the relative but the *absolute* humidity; on this date both were extremely low. It was a pleasant day—although there was a state of air thirst that a full-fledged simoon might equal but could hardly surpass.

It was not a chinook wind or foehn effect, however, where dryness is due to a previous robbery of the moisture from the air. We cannot clearly identify the robbers; we are unable to say where the air was originally lifted and, following expansion, cooled; and a certain amount of water vapor abstracted. Somewhere, far to the west, probably beyond the Mississippi, the moisture was stolen; and the dry air moving slowly to the southeast, was dynamically heated, chiefly by horizontal compression. Air rising loses its load of vapor because the cooling brings about condensation and the water drops out. Air falling generally becomes warmer and drier because its thirst is greater. And for reasons which are given later we can stand warm dry air much better than warm wet air. Indeed there is a direct relation between health and humidity when the temperature is high; and we may even go further and connect happiness and certainly personal comfort with humidity and heat; or in more exact terms comfort is a function of evaporative cooling which in turn depends largely on humidity.

An interesting example of the above relationship can be found in the studies of relative humidity made during the early months of this year by Ellsworth Huntington at Boston hospitals. It seems that in surgical cases the recoveries were more pronounced when moderate humidity and temperature followed high humidity than under other conditions. And what is true for the sick and suffering may hold also for the well and strong in that the sum total of health and happiness may be increased if we can only control the moisture and heat environment. In this control there are three prime factors, ventilation, transpiration and stimulation.

Of these ventilation is perhaps most clearly recognizable in its results, and it is also within our power directly to control it. Let us take so simple a problem as the ventilation of a school room or assembly hall and follow the reactions on poor mortals, as the air thirst varies.

*THE good old bromide, "It isn't the heat as much as it is the humidity," is familiar to all of us. No argument is needed to convince us that a damp hot day is more disagreeable than a dry hot day. Yet to many of us this must have been a good deal of a puzzle. Water, especially cool water, is a universal cooling agent. The moisture present in the atmosphere on a thoroughly uncomfortable muggy day often is distinctly cold and clammy, so that in the moments when we cease steaming we feel the premonitory symptoms of a checked perspiration and an oncoming cold. Yet this moisture doesn't cool us. Why? Dr. McAdie answers this question, pointing out that when the air is saturated it cannot take up our perspiration, and that when we have perspiration without evaporation, nature's process that is designed to make us cool acts only to make us more uncomfortable than ever.*—THE EDITOR.

### The True Rôle of Ventilation

Ten years ago Dr. Gulick, for the Russell Sage Foundation, raised the question whether the air in school rooms directly or indirectly caused the fatigue and lowered vitality so frequently noticed. Was there a subtle poison, such as carbon dioxide or carbon monoxide, or was it lack of oxygen, or was it too much humidity? As finally phrased by the physician, the problem read: "Does anyone know in what respect our present schemes of ventilation are wrong? Why do delicate children and tuberculous persons get well out-of-doors, and fail to do so indoors, and what do we need to do *to make indoor living as healthy as outdoor living?*" (The italics are ours.)

This is a challenge to engineers, especially ventilation experts, also to chemists, physicists and physicians. All are directly concerned. The mental attitude of the various professions to the problem is most interesting. The engineers, for instance, hold that while the problem has a dual nature, being partly engineering and partly hygienic, the engineering part has all been attended to; but the hygienic part, if we may use the words of a very distinguished engineer, "is in very poor shape. It is up to the doctors and not for the engineers to settle." Meanwhile the physicians think it is essentially a question of sufficient supply of fresh air, and therefore an engineering problem. The chemist holds that there are no poison gases in the air, or not enough to produce the results described. The physicist harbors the suspicion that the ventilation experts are not up on the physics of saturated and unsaturated space; that while blowers and fans may furnish enough air, the effect of air thirst has not been sufficiently studied.

The older notions about poisoned air due to exhalations from the body, have been given up. Carbon dioxide was the particular gas which was held responsible and while there is no doubt as to its toxic character there is too little of the gas present, to prove injurious. Under usual conditions, outdoor air contains only three parts in ten thousand of this gas. The specifications for nearly all modern school buildings call for air renewal at the rate of a cubic meter per hour per pupil, and under such conditions the carbon dioxide limit will never be reached. So we may dismiss the poisoned air explanation. But even the best specifications are silent regarding the *thirst trait* of the incoming air, that is, its evaporative and cooling capacity and presumably its vitalizing- or comfort-bringing power.

Let us at this point, correct the story, as it is commonly told, of the Black Hole of Calcutta, and show that it was not poisoned air which caused the death of 123 of the 146 prisoners; but high temperature and a minimum air thirst or saturation. The night was hot, damp and still. There could be no cooling of the skin by evaporation, and profuse perspiration without evaporative cooling meant only extreme discomfort. Fatigue and exhaustion of the sweat glands caused death.

How different was the experience of the soldiers in Mesopotamia during the recent campaign. The heat was intense but the thirst of space for water was very great. Perspiration quickly evaporated and the skin temperature, or *sensible* temperature, was lowered. All that was necessary was to drink enough water. In cases of heat stroke (for these did occur) wet sheets and spraying were resorted to, as substitute sweat layers; and in nearly every case, a marked reduction of temperature and recovery followed.

It seems actually probable that by means of an artificially wetted skin, the traveler in the desert can protect himself against that scourge of the desert, the simoon. There is no poison in the air, as the old books maintain, but just sand and a great air thirst. The air is heated and like a blast from a furnace desiccates. The simoon parches and shrivels; hence the traveler must keep his skin continually moist, or his body becomes heated above the critical temperature.

Will not some ingenious son of the West devise an evaporating mask and an automatic moistener for the traveler over the parched sands? The Arab kneeling and covering his face only half-way protects himself. He could add to his safety by using a damp towel.

With a full appreciation of the psychophysics of the problem we may nevertheless omit consideration of the effects of sunshine, skyshine, shade and the never-ceasing mutation of color, motion, form and sound prevailing outdoors, compared with the monotony of indoors, and come directly to the conclusion that the prime physical difference between fresh air, so-called, and foul air, lies in the water content or humidity, remembering that air thirst is a function of air motion.

The term relative humidity is widely used and little understood. In scientific words, it is the ratio of the pressure of the water vapor present to the pressure when space is saturated. It is a percentage and ordinarily 100 means extreme dampness, rain, fog or mist.

But even in physics, things are not always what they seem to be and relative humidity is no exception. We sometimes have rain when relative humidity is less than 100. What is more troublesome, relative humidity does not mean the same thing if the temperature varies. Thus two localities may be listed as having the same relative humidity but the actual dampness will not be the same. Asheville and Los Angeles have a mean relative humidity in January at 8 p. m. of 72 per cent; but at the former city the weight of the

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# Radium and Its Works

## How the Alpha, Beta and Gamma Rays Are Being Applied in Commerce and in Medicine

By Ralph Howard

IN view of the fact that there is not a pound of radium in the world, it seems rather useless to point out what could be done with a ton of this precious mineral; and yet the fact remains interesting that, according to the late Sir William Ramsay, the energy in a ton of radium, if it could be harnessed to human uses, would propel a ship of 15,000 tons with engines of 15,000 horse-power at a speed of fifteen knots an hour continuously for thirty years. It now requires a million and a half tons of coal to accomplish the same result. Even with the present high price of coal, however, the standard method remains cheapest, since the market value of radium is $3,260,000 per ounce.

General interest in radium and its manifold uses has been revived recently by two occurrences in New York State. The first was the exhibition of three grams of the purified element, worth over $375,000, to New York and visiting physicians at the last annual meeting of the New York Medical Society, held in the Waldorf Astoria Hotel March 23rd-26th. The radium there dislayed was mined entirely from American carnotite deposits discovered in the Paradox Valley of Colorado and in the adjoining districts of Utah. The second was the appeal by a group of scientists to the New York Legislature to appropriate $250,000 for the purchase of two grams of radium, for use in the treatment of cancers, benign tumors, skin diseases and certain forms of tuberculosis.

Along commercial lines the development of radium is proceeding by leaps and bounds. Luminous paint manufactured with radium has long been used for making luminous watch faces, compass faces, and radiolated signs. It has recently been applied also to such daily utilities as hospital call buttons, automobile and motorcycle speedometers, airplane and ship instruments, telegraph dials, steam gages, and poison-bottle indicators. An interesting application has been the manufacture of fish bait where a dab of radium at the end of the hook takes the place of live or artificial bait.

Other uses of daily convenience as well as of commercial importance include: electric-switch push buttons, gasoline gages, mine signs, house numbers, pistol sights, crucifixes, toy doll and animal eyes, electric flash-light locators, theater-seat numbers, key-hole locators, bedroom slipper buttons, door and furniture locator buttons, automobile steering-wheel locks, safe-combination dials, etc.

The therapeutic value of radium has been confirmed and extended in the last few years by a more accurate classification of the effects of the three kinds of rays which radium emits in the process of disintegration. The alpha and the beta rays, it has been found, are the heaviest; at the same time that they have the most pronounced curative effect, they have also the least penetrative energy, so that their chief use is against exposed cancers and diseases of the skin. The gamma rays, on the other hand, are the lightest and possess the greatest penetrative energy; but their curative effect is least pronounced of all. "The gamma ray is in effect a highly penetrative type of X-ray. It is capable of penetrating about eleven inches of solid lead; and of course the human body obstructs it scarcely more than a pane of glass obstructs an ordinary ray of light."

Hence adequate treatment by physicians of superficial malignant growths is accomplished primarily by exposing them to the alpha and beta rays; with deep-seated cancers, the healthy tissue is protected from the alpha and beta rays by a metal screen through which, as well as through the body, the gamma rays penetrate with ease.

The principles by which radium effects its curative work are of notable interest. In the first place, just as certain tissues have a peculiar affinity for certain stains and an antipathy to others, so radium works selectively. It attacks the diseased tissue more quickly than the healthy. Furthermore, a certain amount of irradiation actually stimulates the diseased cells, and makes them grow more successfully; but when that point has been passed, the effect of the radium is to over-stimulate the cells, with the result that they die of a form of fatty degeneration or necrosis. Precisely what the explanation is for these curious phenomena has not yet been determined, and it remains true to this day that in certain malignant growths, all possible amounts of irradiation stimulate the growth instead of checking it. The backers of the radium bank are hopeful, however, that further experimentation will do much to clear these points up.

While the expectation has not been entirely abandoned that radium may some day completely take the place of surgery in the treatment of cancers and allied diseases, its present use is mainly in collaboration with operations. It has been found that the combination is particularly effective, surgery being used as far as possible, with radium as a pre-operative or post-operative aid. In the treatment of facial cancers, radium is exceptionally important, since it leaves no disfiguring scars, otherwise sometimes so horrible as to be worse than the disease itself.

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### The Muscle as a Motor

To the Editor of the SCIENTIFIC AMERICAN:

I would be very glad to have some enlightenment on the following matter: What is known at present about the animal muscular system viewed as an apparatus to convert kinetic (chemical) energy into mechanical power? The ordinary encyclopedial works of reference, at least those with which I am acquainted, give only very vague information.

The points I should like to obtain clearness about are the following:

1. The muscle produces *power* by its alternate contraction against resistance and subsequent relaxation. The amount of the power thus produced is considerable; its ultimate source is evidently the slow oxidation of food constituents after their incorporation in the blood. Now what intermediate stages are interposed between both terminals? Are these *heat, electric current, magnetism* or what?

2. Is the muscle itself a *motor* in the mechanical sense? i.e. Is the conversion of kinetical energy into mechanical power effected within the muscle itself or in some other organ—in the cerebral or nervous system? It appears to me probable that the first is the case and that the nervous system merely plays the part of a transmission or gearing.

3. Is there any remote chance or possibility to *construct a muscle motor* from ordinary non-living materials? In other words, would it ever be feasible, of course not without much minute study by anatomists, physiologists, chemists and mechanical and electrical engineers, to construct an *engine* of which the original source of power would be the slow oxidation by atmospheric oxygen at low temperature of several organic compounds such as carbon hydrates, fats, albuminoids, alcohol, etc., and in which power should ultimately be obtained in the shape of a *contraction* and *relaxation* of a system of complicated *contractible elements* made to emulate the action of the animal muscle?

I find in the well-known work of Dr. Ranke (Der Mensch) the statement that in the human organism about 1/6 of the total amount of heat of combustion of the food can be recovered in the form of *external mechanical power*. If this be correct it is not a bad output for any motor and possibly several other animals, more specially designed to produce power (think of swallows, seagulls, carrier pigeons, etc.) would give a much higher percentage. As to *power* in comparison with *deadweight* the human motor certainly is no record, a fact which accounts for man not having been able until now to fly by his own muscular power. Of course as man and even the lower animals have many other functions besides those of a motor it is not to be expected that in any living organism the theoretical limit as to fuel economy or lightness should be reached.

I think however that the swallow or the seagull might prove on investigation to be *engines* both *lighter* and more *economical* than even our modern flying motors, and if this should prove to be the case there would be I think every inducement for the engineer to try to adopt their methods for the conversion of energy.

For any information on this matter I will be very thankful. N. C. UOOGVLIET.

42 van Galenstroat, The Hague, Holland.

### Cinders and Concrete

To the Editor of the SCIENTIFIC AMERICAN:

In the July 10th issue of your magazine a correspondent wrote of the danger of using "Cinder Concrete." I wish to add our experience, showing the positive folly of using cinder fill in the neighborhood of electrical conduits.

On account of new construction, it becomes necessary to remove a portion of the roof of one of the largest buildings in this city. In the original construction of this roof a six-inch layer of cinders had been laid on the conduits; then seven inches of concrete and finally several layers of roofing paper thoroughly tarred.

The conduits had remained in the cinders eight years only, and in many cases were entirely destroyed, leaving the wires exposed. It would have been impossible to renew or re-install any new wires in these conduits.

The remedy for this condition is to put a grouting of good concrete entirely surrounding the conduits, when the installation is made.

City Electrician, Omaha. ISRAEL LOVETT.

### A Problem in Electrical Engineering

To the Editor of the SCIENTIFIC AMERICAN:

Will some reader kindly advise on the following: I am having great trouble due to burnt-out coils of generators during heavy windstorms on the hills at an altitude of 6,000 feet. The plant consists of generators working at 5,000 volts and transmitting power over 3½ miles of copper to transformer house. The transformers are oil-cooled and inside the transformer house there is a bank of Wentz arresters with choking coils in the mains and grounds straight down to earth plates. These have been working for many years. There is no trouble at the transformer home end.

At the generator and aluminum electrolytic arresters are installed, also water arresters. That is a wire from each of the three conductors (3 phase) is taken down to the water to the three contacts with water and kept so far apart that no current flows. None of these devices are able to protect the machines.

Perhaps some one with experience of lightning could offer suggestions, which will be received with thanks. I would also say that grounded barbed wire has been run over the poles above the line.

Aruvankadu, India. BLUE GUM.

### Mosquito Larvae Killed by Foul Waters

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been called to an article in the SCIENTIFIC AMERICAN of May 1, 1920, under the above title. From the context this would appear to relate to an article published by me in the Public Health Reports of August 8, 1919, and I am therefore taking the liberty of writing you about it, although I have not seen the entire article.

In the quotation from your article, sent to me, emphasis is laid on the observation that the larvæ of Anopheles mosquitoes do not thrive on foul, stagnant water. This statement, I believe, accords with the facts, but the title is apt to be misleading in giving the impression inadvertently that this may be the case with all mosquitoes, which is certainly not true. The more common mosquitoes—the so-called house mosquitoes, Culex and Aedes—flourish prolifically in foul, stagnant water and seem to thrive in proportion to the foulness of the water. This fact is very important in relation to anti-mosquito work in the northern states where Anopheles are relatively rare but the other mosquitoes are abundant. To circulate the impression in such districts that foul waters tend to inhibit mosquito breeding might do a considerable amount of damage.

In view of this possibility would it not be worth while to publish a note in the SCIENTIFIC AMERICAN calling attention to the fact that the above-noted observations apply only to Anopheles mosquitoes?

Woods Hole, Mass. CHAS. W. METZ.

# Where Willow Ware Comes From

## How the Tree Is Grown and Tended to Yield the Raw Materials of Furniture and Basket Factories

By George H. Dacy

FROM an artistic standpoint, the graceful, willowy willow tree which nods and courtseys with the slightest wind has long been admired and complimented as an object of rare beauty. From a utilitarian viewpoint, the willow tree and its kith and kin are just as deserving of commercial acclaim. At present willow furniture is in keen demand, especially on account of its handsome appearance, durability and light weight. Furthermore, the national demand for high-grade willow baskets still holds firm. This domestic industry, which is centered in the neighborhood of Syracuse and Rochester, is chiefly in the hands of large dealers who buy willow from the producers—there being many commercial or willow farms in that section—and peddle them among specialized basket-makers who work at home and are paid a specified sum per dozen—according to size and quality—for the baskets which they turn out.

Forestry experts, versed in basket willow culture, recommend that novitiates restrict their plantings to such varieties as the American green and patent Lemley willows. These require a minimum of cultivation, are easy to peel and ordinarily are in demand on the domestic market at good prices. Under conditions where the cost of peeling is not excessive, the purple willow which yields quality material may also be produced profitably. On account of their large size, American green willows are easier to peel, while this work can be performed at a lower cost per pound than ordinarily obtains. On the average from 6 to 10 tons per acre is a fair yield for this variety although as high as 14 to 15 tons have been harvested under especially propitious conditions. This variety of willow is in demand by furniture makers and the dealers in willow baskets. Although it outranks all other willows produced in the country, it also involves a disadvantage in that it is susceptible to insect attacks and disease. However the willow-shoot sawfly, the stool borer and the leaf rust which attack the American green willows can be controlled although the expenses of such work often are prohibitive.

All basket willows are developed from cuttings from shoots or branches. None but the best stock obtainable should be used, as the plants under such conditions often will last 14 to 15 years. Cuttings usually are purchased by the thousand from reputable growers whose stock is free of disease. Many successful growers have started with 200 to 300 plants and gradually increased as they became more experienced in the business. Cuttings, ordinarily, are set out in the spring and are made about six weeks previous in order that they may callous over at both ends as cuttings which have healed in this manner will grow most rapidly. Care should be exercised against planting any diseased or damaged cuttings as almost invariably they will fail. Selected cuttings from the tall dominant shoots are the ones to plant. Cuttings from one-year-old shoots—10 to 12 inches long—may be set out on a well-prepared, drained, sandy loam soil. If the soil is not in good condition, it is preferable to use cuttings 12 to 18 inches long which are obtained from two-year-old shoots.

A pocket knife is generally used where only a few cuttings are desired, a pruner, a corn knife or a hatchet generally are used. Using ordinary orchard pruners, two men can cut, count and tie about 5,000 American green or 7,000 purple-willow cuttings in ten hours. By strapping one handle of the pruners to a bench in which a groove is cut to hold the lower jaw of the tool, one man can perform as much work as two. The cuttings can be tied in bundles and sawed but there is always danger of damaging them so that the tips will not callous properly, but instead will rot. There are also special machines on the market which the large commercial growers utilize.

Ordinarily the cuttings are set out early in the spring when the soil is moist, the weather cool and before the cuttings show much evidence of growth. A sharpened stick or iron rod from three-eighths to five-eighths of an inch in diameter and three feet long should be used to punch the hole in the soil wherein to set each cutting. Each cutting should protrude about two inches above the ground and should show one or two buds near the surface. Close spacing of the cuttings insures better yields and improved quality. Where the spacing is close, little trouble results from weeds as the plants usually choke them out. Close spacing, however, is disadvantageous in the case of the purple or Lemley varieties as after six or eight years it intensifies the tendency of these plants to die out. Hence on soils of average fertility, according to

(*Continued on page 235*)

1. Bundling the willow rods in the field, after they have been cut. 2. The cutting is done by hand, with a hooked knife. 3. Preparing cuttings for the planting of new patches of willows. 4. Storing the bundles in pits where they remain until the rods are cut up. 5. Peeling basket-willow rods, a slow and expensive hand process

**How the cuttings from which the crops of future years will come are prepared and tended by the modern willow-farmer**

All told there are more than 200 species of willows, a basket willow variety being one which produces long, straight rods suitable for basket-weaving activities. The Federal Forest Service has distributed thousands of willow cuttings to prospective growers in all parts of the country during recent years to the extent that enough successful plantings have obtained to show that the willow can be grown profitably in all sections of the country except where limited precipitation and high elevation obstruct its development. The basket willow demands plenty of moisture and hence it can be produced only in localities where the water table is not lower than from two to six feet below the grade line. A loose, sandy loam provides the best soil conditions while the experienced grower will always select an exposure where the wind has full sweep, where conditions do not favor insect attacks and the development of fungous diseases, where weeds are not rampant and which is located so that it can be worked economically.

## From Water Tower to Lofty Dwelling

ALL sorts of improvisions in the way of dwellings have been shown and described in these columns as the result of the world-wide interest in housing. We have the converted water tower to add to our published collection—an idea, by the way, which might well be applied wherever possible.

Somewhere in New York State there is a wealthy gentleman farmer who has made over his water tower into the lofty dwelling shown in the accompanying views. Using the sturdy wooden framing as a base for subsequent operations, he covered the structure with boards and metal lath, followed by a coat of cement. The tower has been capped with an attractive roof, as shown. A stairway winds about the tower on three sides, terminating at the top on one side of a wide balcony which commands a splendid view of the surrounding country.

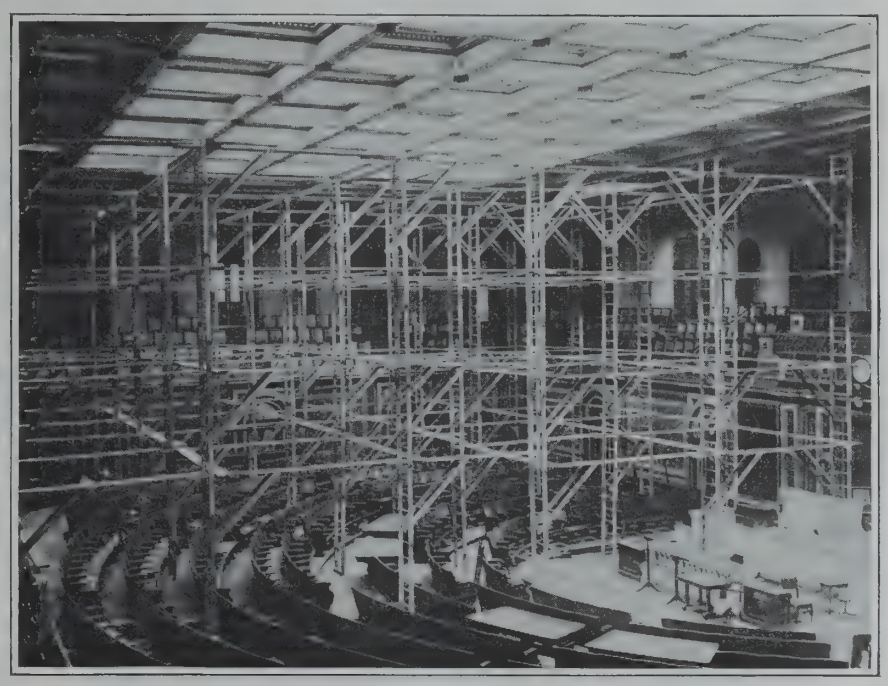
Now the water tank, which supplies water pressure to the master's house and various other buildings about the property, has been left precisely where it was before, namely, at the top of the structure. However, it is now closed in on a level with the top balcony. Below the tank is a large bedroom, and below it a dressing room. The ground floor contains the pumping engine and other equipment, much the same as it was before the conversion. There is a flight of stairs inside, connecting the second and third floors, so that one does not have to go outside in passing from one floor to the other. Electric lights, running water, steam heat and other comforts are included in this odd dwelling which affords much pleasure to its owner.—By *Alfred Langville.*

Copyright, Keystone View Co.

**General view of the converted water tower and a view looking down a flight of stairs leading from the balcony**

## A Congressional House-Cleaning

IF cleanliness is next to godliness, as the old saw has it, then there would appear to be good authority for the poor repute in which our national legislative body is held in some quarters; for the fact is, the chamber in which the House of Representatives holds its sessions has not been cleaned save with broom and mop for the past ten years. This long period of neglect is now being brought to a termination, however, and the entire building occupied by the lower branch of Congress is having a thorough overhauling and cleaning. Our photograph shows the ladders and scaffolding erected for the use of the painters who are giving a new surface to the legislative chamber, and affords some indication that a thorough job of house-cleaning is being done.—By *Ralph Howard.*



**The forest of poles and platforms erected for the use of the cleaners and painters in the House of Representatives**

## Traveling Derrick and Pile-Pulling Scow

MOST persons inspecting one of the mammoth ore docks at Two Harbors, Minnesota, and walking its entire length of more than one thousand feet, would have said that such a structure as this, containing more than 5,000,000 feet of timber, should certainly not be demolished. Yet that is what was done with two of the monster docks at that busy shipping point to make room for the new steel and concrete ore dock.

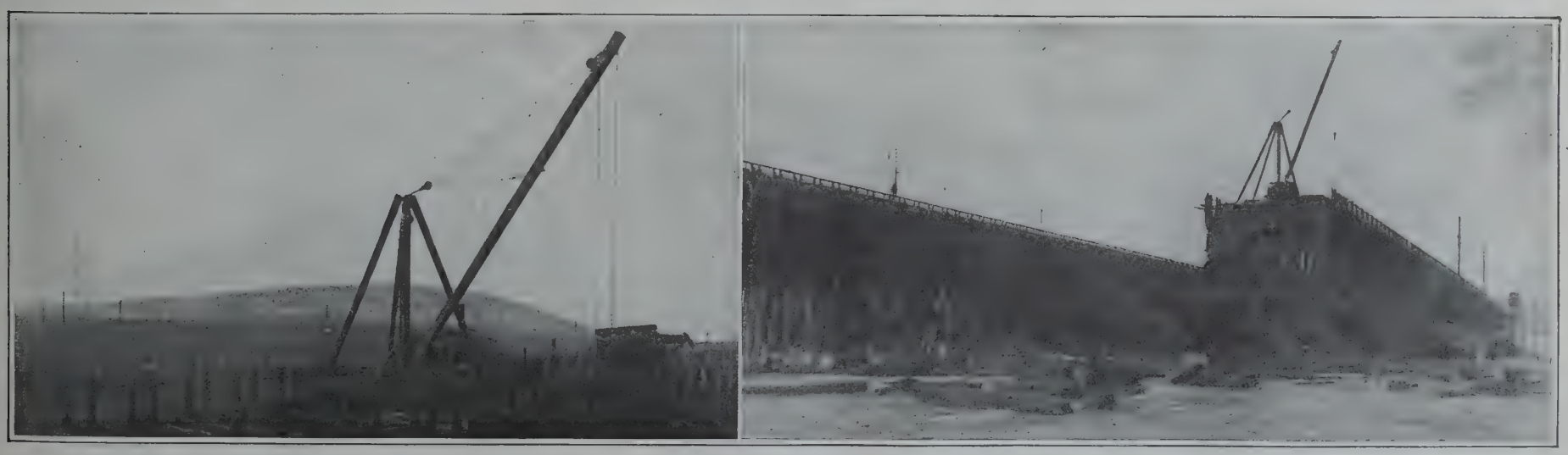
One of these docks was removed entirely; that is, the foundation piles were pulled and the foundation cribs and filling dredged out. The extent of these operations can be judged from the fact that the dock rose to a height of 56 feet, stretched out 1,054 feet, and had 170 pockets. The contractors found it necessary to use a traveling derrick with a 60-foot boom. This was carried on track rails laid on top of the dock. The structure was in such good condition that the work of wrecking it was extremely difficult, and called for many stout pulls. It was a striking example of the apparent waste in modern economy, when the old must make place for the new.

But if the wrecking of the superstructure was difficult the real tug of war came when the work was begun of pulling the long piles of white and Norway pine out of the stiff clay of the lake bottom. Some of these immense piles penetrated the clay more than twenty feet, and offered tremendous resistance. The powerful scow with its modern equipment was, however, equal to handling the work, as by means of lines leading over a heavy steel frame and two sets of five-sheave blocks it could exert a pull of 110 tons on the refractory piles and lift them from their resting places. Some idea of the extent of this undertaking can be gained from imagining that if all the piles that were yanked up out of the mud were spliced end to end to form a gigantic flag pole, then the flag would float at the rather perilous altitude of 20 miles in air.—By *George F. Paul.*

## The Yawing of Ships

IN the course of experiments on the rolling of model ships in which the models were held parallel to waves by a small constraining force, Dr. K. Suyehiro noticed that for a certain range in the period of the waves the model remained always in the same position, while for the other range of the period it had a strong tendency to yaw in one direction or the other, according to a writer in a British paper. When the model was released from constraint it was found that for a certain period of the waves it yawed so as to set itself parallel to the line of the crest and for another period perpendicular to it, just as may be noticed with a boat among waves, especially if it is riding on breaking rollers on a sea shore.

Dr. Suyehiro considers that this method is caused by the action of a gyrostatic couple due to the rotational motion in two different planes at right angles—namely, pitching and rolling; and in a paper before the Institution of Naval Architects he gave a mathematical solution of the problem on this assumption. He pointed out two consequences of the phenomenon. In the first place, when a ship rides on waves nearly synchronous to her natural period of rolling she will be directed square to the waves and relieved from heavy rolling if the period of the waves is a little shorter than her natural period, but will ultimately be exposed to waves abeam and subjected to heavy rolling if the period of the waves is a little longer. In the second place, when a small boat overtakes or is overtaken by a large ship the interaction between the two will be augmented by this yawing phenomenon because the small boat, as it approaches the region of the divergent waves formed by the large ship, will be set in oscillation, and it will be turned so as to lie parallel to the line of them. Hence, if it is not properly steered, the danger of collision will be increased.



**Left: Timber traveler with 60-foot boom carried on track rails on top of ore dock. Right: Position of traveling derrick at work wrecking superstructure of ore dock at Two Harbors, Minn.**

# The Heavens in September, 1920

## How the Stars, in Actual Size, Check Up When We Put Them Against the Sun as a Standard

By Professor Henry Norris Russell, Ph.D.

SINCE first men looked intelligently upon the starry skies, they have doubtless wondered what these shining specks might readily be—at first with the vague questioning of the child in the nursery rhyme, then, as knowledge grew, with gradually greater understanding. Everyone knows now that the stars are huge luminous masses, like the sun, at very great distances; more exact information shows us that if the stars were arranged in the order of their real brightness the sun would not be very far from the middle of the sequence—at least, of the portion known to us. The brightest star—not to our eyes, but in reality—of which we know is Rigel, in Orion, which is some twelve thousand times brighter than the sun; the faintest so far known is the feeble distant attendant of Alpha Centauri, which is a little less than one ten-thousandth as bright as the sun. Between these widely separated extremes we know of hundreds—nay, thousands—of stars of all degrees of luminosity.

But what of the real sizes of these remote bodies? If a star is brighter than the sun, is it also bigger? It may well so happen; but it is not necessarily the case, for if a star is hotter than the sun, and gives out more light per square mile of surface, it may exceed the sun in brightness even though it be somewhat smaller in diameter. Conversely, a star may be fainter than the sun and yet larger in size. The observed sequence of stars, arranged according to the amount of light which they give out, depends therefore in a rather complex fashion upon the interaction of these two factors. Can we hope to separate them, and so come to some knowledge of the true diameters of the stars at large?

In the rare cases of eclipsing double stars (variable stars of the so-called Algol type) we can obtain definite data regarding the relative size and brightness of the two stars of a pair; and in a very few instances spectroscopic data enable us to translate these into actual diameters in miles. In these instances the stars usually turn out to be bigger than the sun, but not very much bigger—five or six times the sun's diameter being exceptionally large.

But these few cases are hardly enough to trust as a fair sample of the stars in general, with their great variety of brightness and color. To go further, we must try to get some way of estimating how much light a star gives off from each square mile of surface—its surface-brightness.

### Optical Pyrometry Upon the Stars

It is a commonplace of experience that, as any solid body is heated hotter and hotter, it begins to shine, and shines more and more intensely, while at the same time the color of its light, at first dull red, becomes yellower, and at last white. The theory of radiation, which is now well developed, enables us to give numerical exactness to these qualitative impressions, and to estimate the temperature of any hot body from the color of the light which it gives off. Indeed, this "color-match" method of determining temperature is of sufficient accuracy to be of practical usefulness in some industries which employ highly heated furnaces. By an extension of the same principle, we may estimate the temperature, and also the surface-brightness, of a star, if only we know its color. To be sure, the stars are not solid bodies, but masses of gas; yet there is good reason to believe that this does not seriously vitiate the application of the theory. Several lines of attack are open. The simplest is afforded by the eclipsing variables already mentioned. Here in many cases we find systems composed of a large faint star and a smaller, but brighter, one which is eclipsed behind it. In these systems the large faint star is always found to be red, and the small bright one white. And, in general, the greater the difference in color, the greater also is that in surface-brightness.

Other methods of investigation lead to similar conclusions, and, though the data are still scanty, all are in tolerable agreement as to the degree in which surface-brightness varies with difference in the color of the star—or, for that matter, with the class of the star's spectrum, which is very intimately associated with the color of its light.

From the available data, it seems probable that the whitest and hottest stars, like those in the belt of Orion, give out about twenty times as much light per square mile as the sun does. Stars like Sirius, a step lower in temperature and color, may be of seven or eight times the sun's surface-brightness; and yellowish stars, like Procyon, twice as bright as the sun. Those resembling the sun in color and spectrum may be assumed to be similar also in surface-brightness; but orange stars, like Arcturus, are probably of about one-sixth the surface-brightness of the sun, while red stars like Antares may fall as low as one-thirtieth, or even lower.

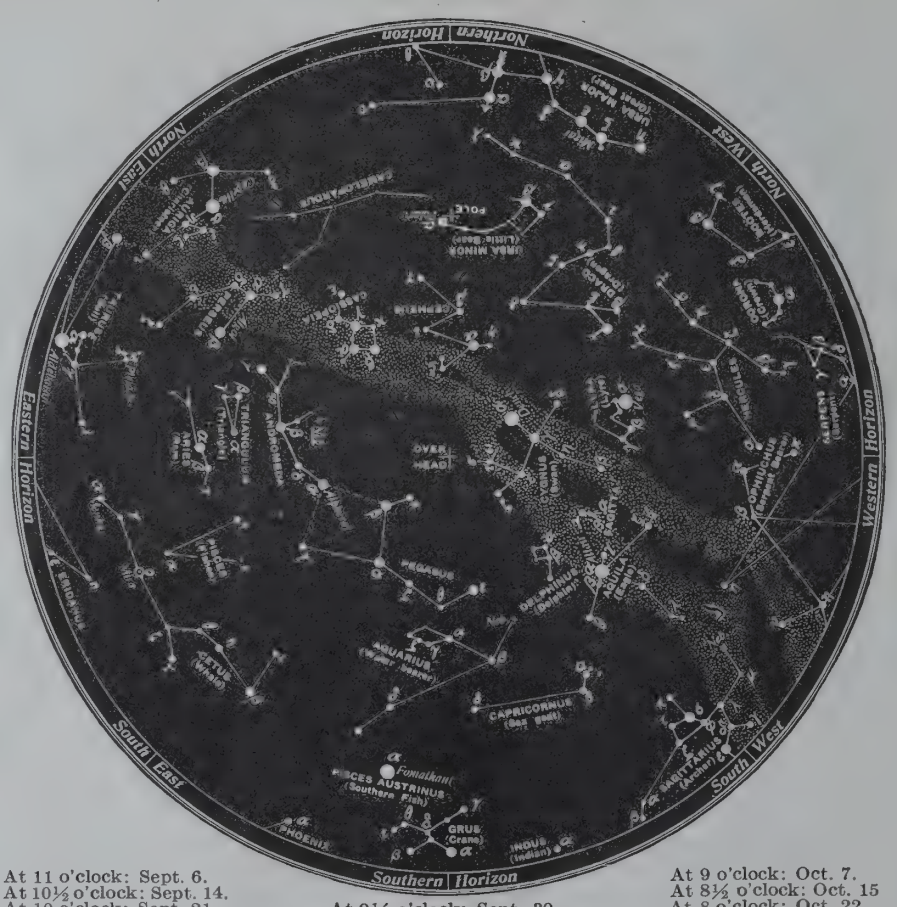
### Big Stars—and Bigger Ones

Fortified with these estimates, we may proceed to figure out how big some of the familiar stars are. Let us begin with Scorpio—so well seen in the summer sky. The principal stars of this constellation are remote and very bright. All but Antares are also very white, and doubtless very hot. The brightest of these is Lambda Scorpio, at the end of the tail, which gives out about 1,500 times as much light as the sun. Being so white, we may estimate its surface-brightness as 15 to 20 times the sun's—which makes its area from 75 to 100 times that of the sun, and its diameter nine or ten times the sun's—taking round numbers. The other conspicuous stars of the constellation are a little fainter, and probably somewhat smaller; but all of them are probably several million miles in diameter. Antares, however, is an exception. It is enormously bright, giving out about 3,000 times the sun's light, and is also very red. Estimating its surface-brightness, correspondingly, as one-thirtieth the sun's, we reach the enormous area of 90,000 times the sun's, and a diameter 300 times that of the sun, or a quarter of a billion miles. Extraordinary as this result may seem—a star so huge that the whole orbit of the earth could be put inside it—it is hard to see what modifying factors could greatly alter the estimate; and of course such an object is very small indeed in comparison with the nebulæ, which are hundreds or thousands of times greater in diameter.

Of the other conspicuous summer stars, Arcturus is probably the biggest. It has a little over 120 times the sun's luminosity, probably some seven times its area, and roughly 25 times its diameter. Vega, which is a little nearer than Arcturus, and gives out about five-sixths as much light, is a white star, and its diameter works out about four times that of the sun. Altair is a relatively near neighbor of ours, and is actually only some eight times as bright as the sun, and probably three times as bright per square mile—which makes its diameter half as great again as the sun's. Procyon, which is a little fainter and a little yellower and cooler, is probably very much the same size as Altair. Sirius, some 25 times as bright as the sun, is white, and its probable diameter is twice the sun's. Rigel, which gives evidence of being hotter than Sirius, has perhaps ten times the sun's surface brightness, which would make its diameter 35 times that of the sun, but only about one-tenth that of Antares.

So the story goes. Of the stars which are conspicuous to the naked eye, some, which owe their apparent brightness to their proximity, are but little larger than the sun in actual diameter. Others, which are remote and of great real brightness, run much larger—especially the giant red stars; but there are probably very few that exceed the dimensions computed above for Antares.

To find stars smaller than the sun we must look among the faint members. Take for example the well-known double, 61 Cygni. The stars of this pair are about 1/20 and 1/40 as bright as the sun. They are also orange-red in color, and their surface-brightness may be estimated as 1/20 that of the sun, which makes the diameter of the brighter component about equal to the sun's, and that of the fainter three-quarters as great. Passing to still fainter objects, we may take Barnard's star—the second nearest in the heavens—which gives out 1/2,500 of the sun's light. This is an extremely red star, and its surface-brightness, on the basis of our previous estimates, would be perhaps 1/50 of the sun's. This would make its diameter about one-seventh of the sun's, or some 120,000 miles. There is some reason to believe that this is too small an estimate, and that these very faint stars give out even less light per square mile than we have suggested. None of these tiny stars, however, can be seen without a telescope, and hence our conclusion stands, that the stars visible without instrumental aid are for the most part of the size of the sun or larger, but that the large majority of them are less than ten times the diameter of the sun, while a very few run up to the size of the earth's orbit.




At 11 o'clock: Sept. 6.
At 10½ o'clock: Sept. 14.
At 10 o'clock: Sept. 21.
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15
At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

**NIGHT SKY: SEPTEMBER AND OCTOBER**

### The Heavens

Our map shows the appearance of the sky in the later part of the evening, when the summer constellations are nearly gone and those of winter are beginning to rise. Sagittarius, Ophiuchus and Bootes are setting. Hercules and Aquila are still in sight with Lyra above and between them and Cygnus still higher. Fomalhaut is the only conspicuous star in the south, and Pegasus and Cetus are the principal constellations in the southeast. Andromeda, Perseus and Aries are well up in the east and northeast, while Taurus and Auriga are rising. The Great Bear is low in the north; Draco and Ursa Minor are above, and Cassiopeia and Cepheus still higher.

### The Planets

Mercury is in conjunction with the sun on the 8th, and becomes an evening star; but he is practically invisible until the end of the month, when he sets three-quarters of an hour later than the sun, and can be seen in the twilight, though not so well as next month.

Venus is also an evening star, and is gradually becoming more conspicuous. At the end of the month she sets half an hour later than Mercury, and should

(Continued on page 235)

# UNDARK

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## *"I want that on mine"*

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UNDARK is a factor for safety and service wherever it is used. It will make your car's gauges give the same 24-hour sight service that UNDARK gives to watch dials.

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If you are interested in seeing how UNDARK can be applied, we will send you a TRY-OUT set for $3.00. We can also give you the names of manufacturers who use UNDARK on the particular articles in which you are interested.

*UNDARK can be successfully applied by manufacturers in their own plants. It is a simple process. We will instruct operators and organize the work for you. Write for details.*

**UNDARK is used on numerous articles, of which the following are the most important**

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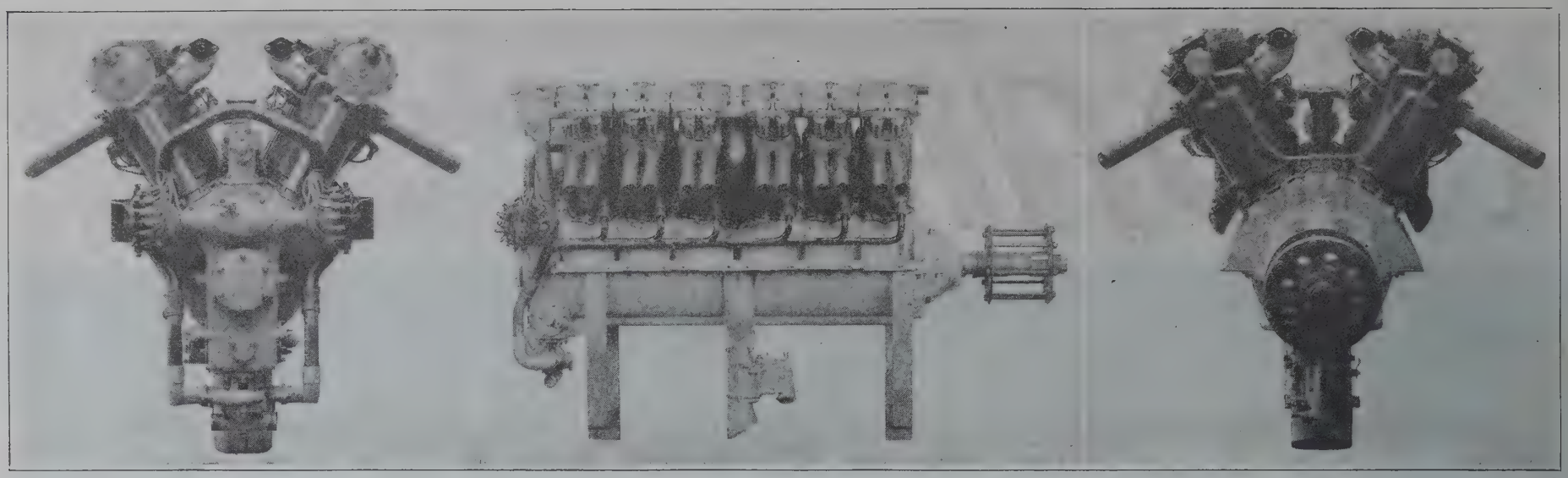
| Flashlights | Steam and Pressure Gauges |
| Pull-Chain Pendants | Revolver Sights |
| Push-Button Switches | Telephone Mouthpiece |
| Flip Switches | Fire Extinguishers |
| Door Bells | Mine Signs |
| House Numbers | Women's Felt Slippers |
| Hospital Call Bells | Fish Bait |
| Ship's Compasses | Theatre Seat Numbers |
| Locks | Convention Buttons |
| Safe Combinations | Poison Indicators |

**Names of the makers of these furnished upon request**

**Radium Luminous Material Corporation, 58 Pine St., New York City**

**Factories: Orange, N. J. Mines: Colorado and Utah**

Trade Mark Name UNDARK Reg. Applied for



*Left:* Rear view of engine, showing the accessibility of the water pump at the rear of and below the crank case. *Center:* Right side of engine. Note the single duplex carburetor, set below and outside the crank case. This constitutes the outstanding feature of the design. This not only makes the engine fire proof so far as the carburetor is concerned, but solves the problems of synchronizing throttle and altitude control and saves weight. *Right:* Front view of engine. The included angle of the cylinder groups is 60 degrees. The individual type of cylinders, which provide the best water circulation and thus keep the cylinders cool and avoid valve trouble, are used

**Three views of the engine recently designed by Col. Jesse G. Vincent, which incorporates several novel features and gives remarkable results for its weight**

## A Forward Step in American Airplane Engines

**By Col. Jesse G. Vincent**

IT needs but a superficial study of present-day airplane design to convince even the uninitiated that the airplane of the future will be larger, have greater load capacity and more radius than the planes we have today. In order to accomplish this larger engines will be required or else the power plant must be divided among many small units.

It is an engineering axiom that a few large engines will generate a certain number of horse-power more efficiently than a greater number of small engines. There is also a greater degree of reliability to be secured with the larger engine, since it is possible for the same weight per horse-power to design parts with a greater factor of safety and small flaws and imperfections are less liable to interfere seriously with the strength of the larger parts.

It is evident then, that the evolution of the airplane will closely follow the development of the engine. It was at first thought that the air propeller placed a definite limitation on the possible size of an airplane engine. This limitation undoubtedly still exists, but engine design has not yet been definitely affected by this factor.

Good engineering practice requires that a design be based on certain practical and theoretical conclusions and it therefore follows that a new engine design must be based on the experience gained with engines which are comparable in size and general design with the proposed engine. With the great amount of experience gained with the Liberty motor at my disposal and also after study of the performances of all the best foreign engines, I undertook the design of this engine having about 25 per cent greater displacement than the Liberty with perfect confidence that the engine would prove fully as efficient and reliable as the Liberty and in addition would have features which experience had demonstrated were desirable.

The carburetor arrangement called for the principal departure from previous designs, and tests which have been made on the ground and in the air have demonstrated the desirability of this design from every standpoint. A single duplex carburetor is bolted to the underside of the lower half of the crankcase and the intake passages are cast integral with the upper and lower halves of the crankcase. Suitable manifold extensions serve to connect the cylinders and passages.

This arrangement presents many advantages. Firstly, it locates the carburetor in a low position in the plane which permits of a gravity fuel system, the simplest and most positive method of insuring a constant supply of fuel to the carburetor, eliminating the complication and added weight of fuel pumps, piping, valves, etc.

Secondly, the carburetor air-intake is allowed to project through the lower cowling of the fuselage and in this manner all fire hazard due to a back-fire is removed, it being noted that all gasoline vents discharge into the air-intake so that gasoline leaks within the cowling are absolutely prevented. This makes the airplane entirely fireproof for all civil uses.

The third advantage in connection with the use of a single carbureter is that a single adjustment suffices for the whcle engine. In previous large engines it had been the practice to employ as many as four separate carburetors and it was practically impossible to make the idling, running and altitude adjustments the same for all cylinders.

It is interesting to note that this carburetor is probably one of the largest built and is capable of handling sixty gallons of gasoline every hour!

(*Continued on page 236*)

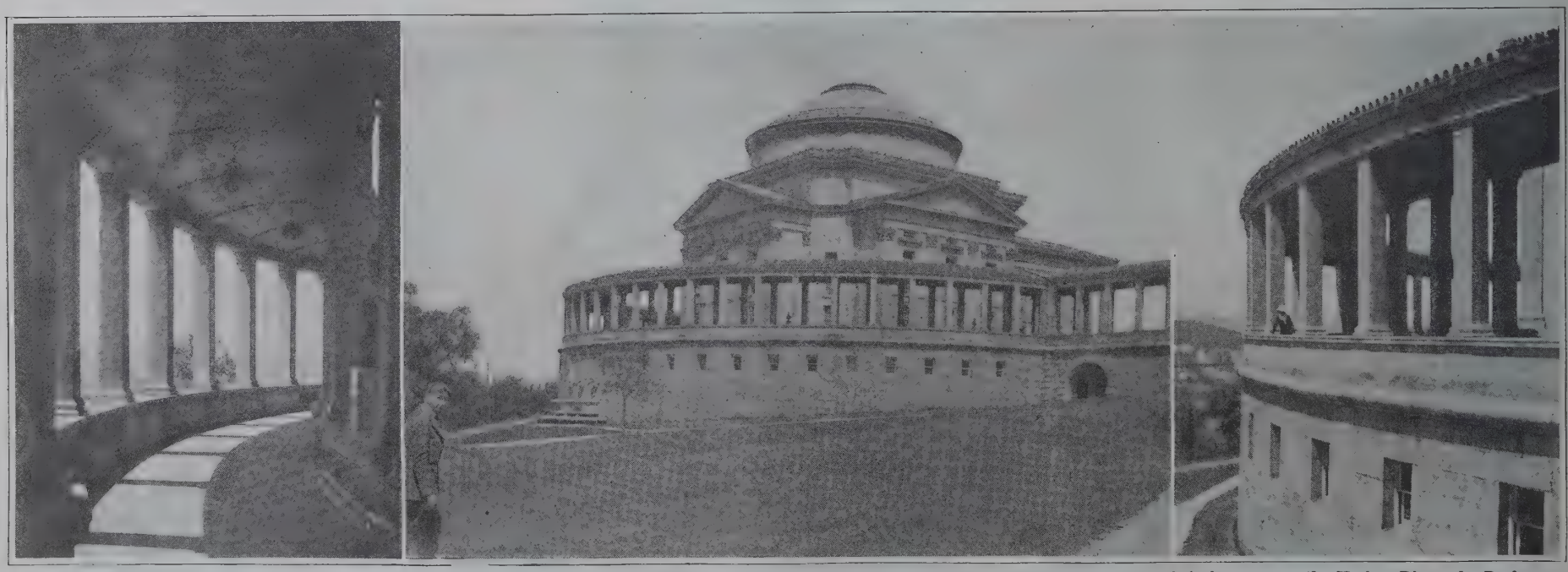
## This Year's Nominations for the Hall of Fame

THE ballot for the fifth quinquennial election of the Hall of Fame has already been to the board of 102 electors and votes for the various candidates on the ballot will be received by the Senate of New York University until October 15. Announcement will be made on November 1 of the names that have been chosen by the electors for inscription in the Hall. The names of 68 men and 4 women who have not been candidates in previous Hall of Fame elections appear on this year's ballot, as well as several score of other names that have been voted upon in former elections but which failed to receive a sufficient number of votes to elect.

There are 11 inventors and 10 scientists whose names will be voted upon this year. Of the 11 inventors 5 are new nominations: Ottmar Mergenthaler, inventor of the linotype machine; William Austin Burt, inventor of the solar compass, the equatorial sextant compass and a very early typewriter; Stockton Barton, inventor of sewing machine devices; Robert L. Stevens, inventor of engineering devices; and Walter Hunt, nominated as the real inventor of the sewing machine. The 6 inventors whose names were acted upon in previous elections but who did not receive the number of votes necessary to elect but obtained a sufficient number to place them upon the ballot again this year are Charles Goodyear, Richard Marsh Hoe, Cyrus Hall McCormick, John Ericsson, Robert McCormick, and George Henry Corliss.

Walter Hunt, nominated by his grandson as the "real inventor of the sewing machine," is perhaps the most interesting of the new nominations for the reason that five years ago Elias Howe was elected to the Hall of Fame as the inventor of the sewing machine and Howe's name has already been inscribed on a

(*Continued on page 236*)



*Left:* Interior view of the Hall of Fame. *Center:* The Hall as seen from the park at the rear. *Right:* The corridor of the Hall of Fame, which looks out over the Harlem River, the Dyckman Valley, and even a small section of the Palisades beyond

**The Hall of Fame on University Heights, New York City**

# FORD ECONOMY

## *How Gargoyle Mobiloil "E" reduces friction-heat, carbon and wear*

WHEN a Ford owner turns to Gargoyle Mobiloil "E" he nearly always gets one of the big surprises of his motoring experience.

He finds that engine overheating—excess carbon forming—spark plugs fouling—excessive gasoline and oil consumption—excessive friction and wear, are all unnecessary.

He finds that the Ford high-speed conditions *need* not invite frequent overheating.

He finds that he never before really knew how little carbon need accumulate in a Ford engine.

He finds that previous fuel and oil consumption were unnecessarily high.

He finds that frequent repairs and replacements of worn parts are no longer necessary.

He secures new power, especially noticeable on the hills.

The ability of Gargoyle Mobiloil "E" to reach all moving parts is due to its scientifically correct *body*. Its ability to absorb and radiate heat and give full protection to the frictional surfaces is due both to its high *quality* and to its correct *body* and *character*.

This means full protection—particularly vital to a Ford when low gear is in frequent use.

Combustion heat plus excessive friction heat causes overheating of the engine, boiling and evaporation of water from the radiator and unnecessary wear of the moving parts. Water is cheap. Repairs and replacements are not. Ford economy—great under all conditions—is made even greater through the year around use of Gargoyle Mobiloil "E".

This has been demonstrated repeatedly in all parts of the world. It is being proved daily all over the United States—*perhaps today by your next-door neighbor!*

With your oil reservoir emptied and refilled with Gargoyle Mobiloil "E", your engine will give you quick and ample evidence.

Write today to our nearest branch for a copy of our booklet, "Your Ford—Four Economies in its Operation." It gives the vital facts in regard to Ford lubrication.

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VACUUM OIL COMPANY *Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.* NEW YORK, U.S.A.

# Smothering Fire with Bubbles of Gas

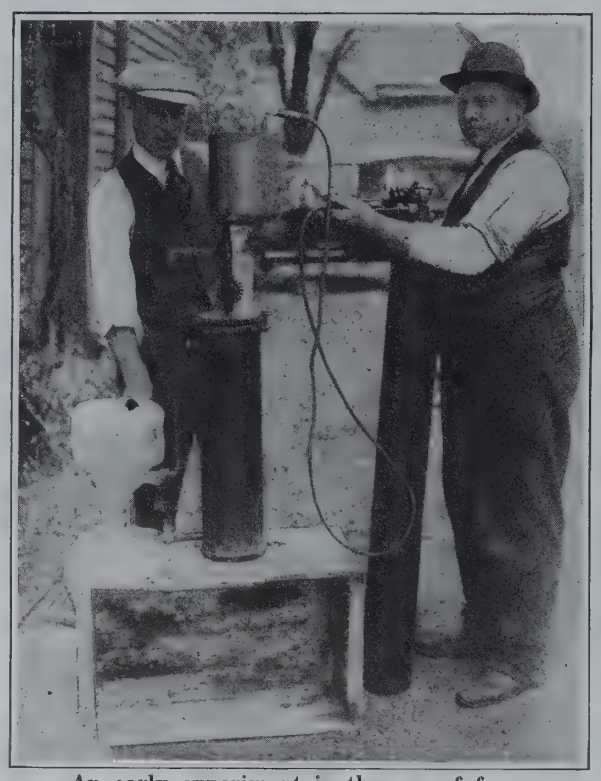
## How Carbon Dioxide Protects the Oil Tank Against Its Greatest Hazard

By J. F. Springer

STORAGE is a necessity in the business of producing petroleum. The problem of providing it is a gigantic one because of the vast quantities of oil that must be put into reservoirs and because of the excessive liability to destruction by fire. A typical oil reservoir will be, say, a circular steel tank having a capacity of 50,000 gallons. In an active oil field, such tanks may cover the visible landscape. Some day, suddenly, a lightning stroke will start oil in one of the tanks to burning. Under ordinary circumstances all the oil of this tank will be consumed in the conflagration and the owners will be content if only the fire does not spread. Only indifferent success seems to have attended the use of water and other liquids in respect to the extinction of a flame once started on the surface of a large body of oil. Petroleum is exceedingly combustible, being made up almost entirely of hydrogen and carbon in compounds tremendously eager to split up and give the constituent elements to any free oxygen in the neighborhood. Water acts by smothering combustion through preventing the access of the oxygen in the atmosphere. Other liquids either act similarly or produce gaseous material which performs the smothering operation. The problem of extinguishing the fire consists in getting the liquid or gaseous blanket all over the flaming surface.

But a new thought occurred to an American inventor some years ago when the century was young. This is the *foam* or the *suds* idea. Mr. Elmer Gates noted that if a given weight of fire-extinguishing liquid was first converted into a lather, the effect upon the flame is multiplied over what it would have been if used in the ordinary way. The greatly increased bulk of the liquid when converted into froth enabled it to screen the air, therefore the oxygen, from the surface on to which the fire-extinguishing material might be thrown. Over and above the foregoing idea was another entertained by the same inventor. He saw that if the bubbles of froth should themselves contain instead of air some other gas which was a non-supporter of combustion, the effectiveness of the suds would be enhanced. As the bubbles burst, their gaseous contents mingle with the air in the immediate vicinity and thus render it a less active supporter of combustion. Such gases as nitrogen, ammonia, carbon dioxide, are suited for the filling of bubbles. A gas of this kind may be very quickly mixed with the liquid from which the suds is made and a very large amount of the foam brought into existence. He considered that the bubble-like lather should contain inorganic salts of such character that upon heating they would decompose and evolve incombustible gases.

Here, apparently, we have the origin of the process which has subsequently been developed and utilized for the extinction of petroleum conflagrations and great and small fires of a more ordinary character. Mr. Gates' patent was issued January 12, 1904. He specifies for a suitable mixture a thick solution of ammonium soap. This may contain, for example, dissolved borax or ammonium sulfate. This solution, when ejected from a suitable nozzle, by pressure of a non-combustible gas, constituted his foam jet for the extinction of fires—the ancestor of the present successful means of using bubbles.



**An early experiment in the use of foam extinguishers**

Germany seems to have been the scene of the next developments. The early method took no account of the difficulty of forcing foam through conduits. Besides, it rather assumed that the mixture was already prepared. Consequently, with provision for maintaining separately the liquids to be mixed and effecting their mixture only at the time of use and close to the point of use, important advances were made. The older method was adapted to small hand apparatus. In the case of a petroleum tank, where large masses of foam were needed quickly on the surface of the oil, difficulties were encountered. These related particularly to the fact that with the older method the foam was forced through long conduits. During its passage, it was more or less subject to reconversion into liquid. Besides, the gas pressure behind it was somewhat liable to be impaired when the foam reached the tank. The improvements, due apparently to Herr Ernst Bartels, consisted principally in forcing two liquids through separate conduits to the immediate vicinity of the oil surface and there mixing them. A mixing chamber was provided; and from it the foam generated by the chemical reactions set up by the conjunction of the two liquids was ejected on to the oil. The Bartels English Patent was issued October 5, 1911.

In the meantime a United States patent was issued to certain officers of the Standard Oil Company of California for a system using two liquids of such composition that, when brought together, the gas carbon dioxide would be generated. This patent was issued February 21, 1911. About this time the United States Navy became concerned over the question of extinguishing fires on board oil-burning ships. A special board after deliberation recommended the use of the foam system. At Bayonne, N. J., on the border of New York Harbor, a tank 16 x 4 feet in area was filled to the depth of 5 inches with naphtha and set on fire. The flames rose to a height of twenty feet. But an application of a fire-extinguishing suds put the fire out in a few minutes. The liquids employed upon this occasion were probably formed more or less in accordance with the following recipes, the figures referring to parts by weight. Liquid No. 1: Glue, 1; glucose, ½; sodium bicarbonate, 7½; salicylic acid, ¼; water, 100. Liquid No. 2: Aluminum sulfate, 10; water, 100. The aluminum sulfate [$Al_2(SO_4)_3$] and the sodium bicarbonate ($NaHCO_3$) react upon each other and evolve carbon dioxide ($CO_2$). The foam is readily produced because of the presence of the glue and glucose. The salicylic acid acts as a preservative of the glucose. The glucose has an additional duty, that of stabilizer. In liquid No. 2 sulfuric acid was tried as stabilizer, but its corrosive effect on the container was objectionable. The volume of foam is eight times that of the combined liquids.

It is, naturally, very necessary that a good suds be made. Of the substances used for this purpose, an extract of licorice root is apparently one of the best. It was mentioned in this connection as far back as 1906 in the provisional application of Prof. A. G. Laurent of St. Petersburg, for an English patent. The most modern development of the foam system also employs it. Thus, the following percentages (again by weight) represent a pair of mixtures which are up to date, the "suds material" being a secondary extract of licorice root. Solution No. 1: Aluminum sulfate, 11; water 89. Solution No. 2: Suds material, 3; sodium bicarbonate, 8; water, 89. It will be noted that we have here an acid and an alkaline solution. The suds material is here put with the latter. Upon being mixed, the volume is increased to about ten times that of the original total. The bubbles will be fine and tenacious and will be filled with carbon dioxide. Moreover, the whole will flow well. The chemical reaction between the aluminum sulfate and the sodium bicarbonate is as follows:

$$Al_2(SO_4)_3 + 6\,NaHCO_3 = 3Na_2SO_4 + AL_2(OH)_6 + 6CO_2$$

When the bubble mass has done its work, the carbon

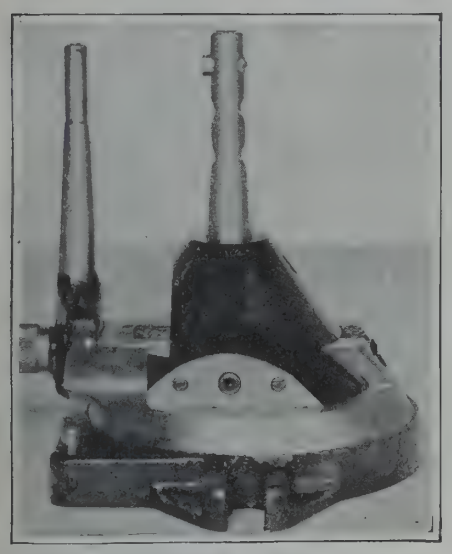
(*Continued on page 237*)

**Discharging foam on to burning oil from a stationary device**

**A bad fire at Philadelphia in which several firemen were killed**

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*



**This device dresses grinding wheels accurately and quickly**

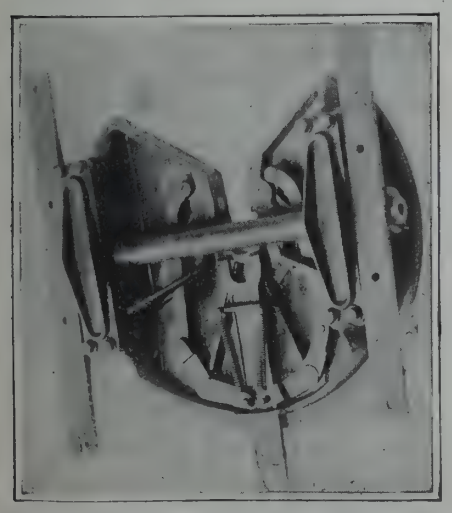
## An Accurate Grinding-Wheel Dresser

A NEW tool for dressing abrasive wheels with radial or angular faces has been introduced by a Detroit manufacturer. This tool will dress a 12-inch wheel to a radius of from 0 to 1¼ inch, either convex or concave, and to any angle desired. The tool post has three splines so the diamond may be set at right angles with the travel of the side for dressing angles. It also has 2-inch center height adjustment. When the distance from the back of the measuring post to the pivot center is known to be 3 inches then it is only a matter of addition or subtraction to obtain the required convex or concave curve.

## An Automatic Trailer Connection Device

A DEVICE for automatically coupling a trailer with a motor truck is a new product of a Massachusetts manufacturer. By using this device it is not necessary to use jacks to make the connection. As the tractor vehicle backs into the trailer a cam formed by the rear end of the device sliding down raises the trailer and continued backing couples it automatically.

When disconnecting the wheels of the trailer are blocked and a horse is placed under it. As a lever near the driver's seat is pulled the truck is disengaged from the coupling and enabled to move away from the trailer.

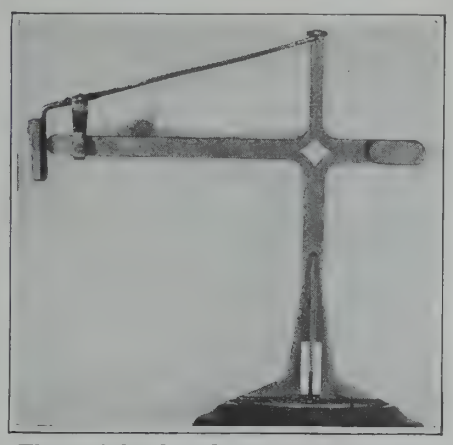


**This device for coupling trailer and truck does away with jacks**

## Is the Phonograph Fast or Slow?

SINCE the pitch of any photograph changes with the speed of operation, it is obvious that proper results can be had only when the correct speed obtains. Most phonographs are equipped with devices of one form or another to indicate the speed of the turntable, but in many instances these devices are not accurate. It is necessary to have recourse to some other method, such as counting the turns per minute, in order to check up the speed.

Among recent phonograph inventions is a speed indicator, which is shown in the accompanying illustration. This device consists of a small base which fits over the pin on the phonograph turntable, a standard, and a pivoted and weighted arm which serves as the indicator. The device is placed on a phonograph record which is to be played. As the turntable reaches its set speed,



**The weighted and pivoted arm indicates the speed of the phonograph**

a little weight at the end of the pivoted arm is thrown outward by the centrifugal force. The extent of this movement is indicated by the other end of the arm, which passes over a scale on the standard. The scale is of such simplicity that it can be readily read while the device is whirling around.

## Speeding Up the Rowboat with Paddlewheels

EVERY so often someone comes forth with a scheme for placing paddlewheels on a rowboat. This time it is an Englishman, who has been making small boats fitted with paddlewheels, as shown in the accompanying illustration. The paddlewheels are turned by means of cranks, and it is said that this method of propulsion has met with much favor at English summer resorts.

## New Cold Process for Vulcanizing Rubber

IT is reported that a very important discovery of a new process of vulcanizing rubber has been made by Professor Peachey of the Manchester (England) College of Technology. Laboratory experiments prove that the process will have far-reaching effects on the rubber-manufacturing industry. The importance of the discovery is in the fact that it is a method of cold vulcanizing. It makes use of two gases, sulfretted hydrogen and sulfur dioxide, which react on each other to produce water and free sulfur. The professor has found that when crude rubber, either in a solid form or in solution, is treated with these two gases the sulfur produced by their interaction vulcanizes the rubber. If the rubber be mixed with a waste material such as sawdust or leather scraps or paper, and the mixture is vulcanized, the resultant materials will serve a variety of useful purposes.

## A New Bar Straigtening Machine

A MACHINE for straightening bar stock up to 2 inches in diameter has lately been introduced by an Illinois manufacturer. V-blocks support the work while it is being acted upon by the screw. When the screw is elevated two sets of spring-actuated rolls lift the bars above the Vs so that it may be easily rotated.

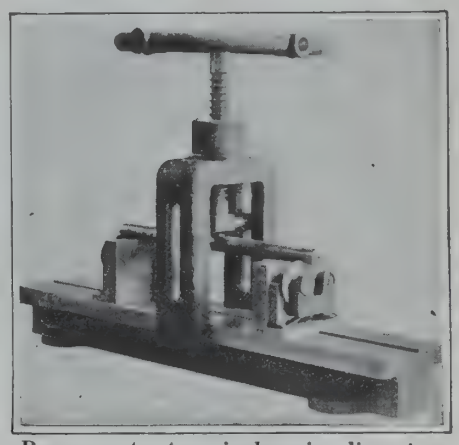
## A Washing Block for the One-Armed Man

THERE are some things that a one-armed man can do for himself with no trouble and with no special apparatus. There are other things, doubtless, that he can't do for himself, with all the trouble in the world and all the ingenious devices that might be brought to bear on the problem. But between the two extremes there are a great many things that he can do for himself with the aid of a little patience and a little ingenuity; and one of these concerns the washing of his lone hand and arm. The cleansing of other parts of his anatomy presents no special problem; but how to wash a hand effectively with no other hand to conduct the operation is not immediately clear. A German inventor has made it clear, however, with the little apparatus which we illustrate.

The curved inner surface of the wooden block which constitutes the

**England is having much fun these days with paddlewheel rowboats**

foundation of the device is cut approximately to the shape and size of the human arm. It is lined at different points with several fabrics of different degrees of harshness and softness, and with a coarse brush so that it is ready for any kind of a scrubbing job from axle-grease to the mere dead skin and excretions of the night. On its short upright it carries a finer brush for the knuckles; on its outer face it presents a bit of abrasive cloth for the filing of the finger nails; and at the top of the long arm is found a nail-cleaner which, in distinction from its prototype in ordinary use, is held stationary while the nail of the user is drawn about it. Finally, it holds a towel, securely fastened at both ends. With this outfit the one-armed man is able to complete his toilet so far as it refers to his hand and arm, and to maintain himself on an equal basis of cleanliness with any of his more fortunate two-armed brethren.



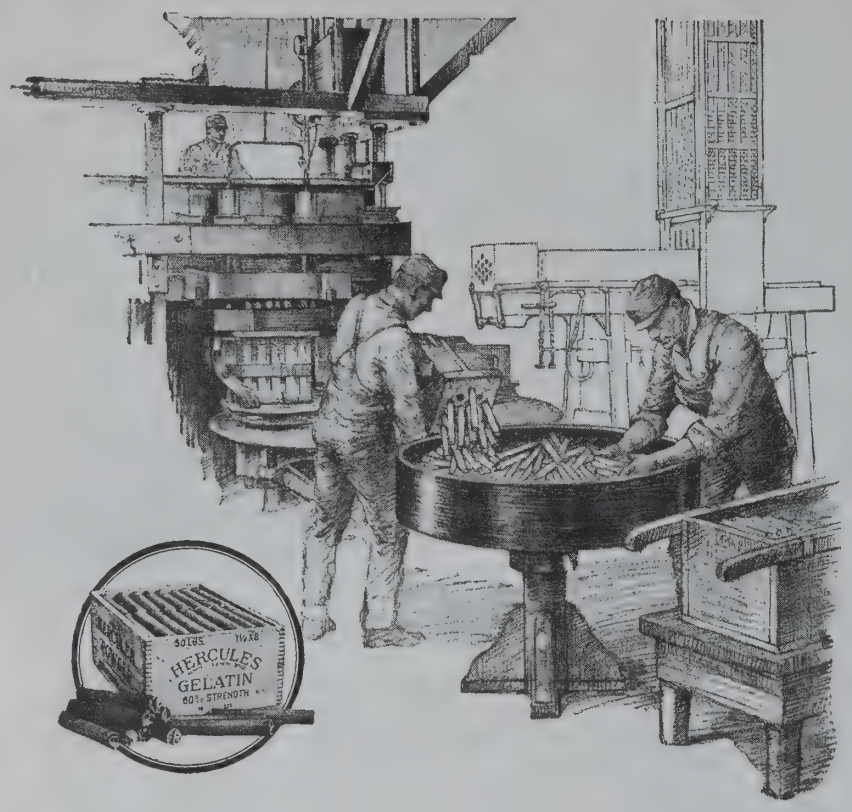
**Bars up to two inches in diameter can be straightened with this device**

## Latest Patent Decisions

**Commercial Success as a Measure of Utility:**—This is a suit in equity by the Whitlock Coil Pipe Co. against the Mayo Radiator Co. The decree herein is for the defendant. The pleadings raised the issue of non-infringement and invalidity. The patent refers to the invention as an apparatus for effecting the cooling of one fluid by the application of another and cooler fluid, such as the cooling of air by water, or of water by air—the condensation of steam by either air or water. In the patent, the patentee says: "That portion of the apparatus to which my invention relates, in common with other and similar apparatus, comprises a series of air tubes surrounded with water passages forming part of a water circulating system, by which the water which has become heated by its contact with the cylinder will lose its heat, and by its contact with the air tubes, through which, in order to increase the efficiency of the apparatus, the currents of air are caused to move." The plaintiff sues on all the claims of the patent. The court holds that there has never been made, with any commercial success, a structure which conforms to the specifications and claims in suit. It would be unfair to claim that the defendant's device infringes the plaintiff's device when the latter has added no substantial value to the art. To sustain the claim of the infringement would be to interpret the language of the claim as broad enough to

(*Continued on page 238*)

**With this device the one-armed man can wash, and wash clean**




# It's the Man That Counts

The human element probably plays a more important part in the making of explosives than in any other manufacturing process conducted on a large scale. There are no machines in the twelve great Hercules plants that need only to be started at the beginning of a day, stopped at the end, and which in the meantime carry out their tasks without attention.

Every machine used in the making of Hercules Explosives has a man for its master. Every motion it makes is watched. The results of its work are carefully checked. Nothing is ever taken for granted. No machine is looked upon as infallible.

In the gelatin packing house, for example, is a large machine which fills paper cartridges with *Hercules Gelatin Dynamite. Although this machine works with almost positive precision and accuracy, every cartridge which comes from it is inspected *twice* to make certain that it is properly packed. One inspection takes place immediately after the cartridge leaves the machine. Another before it is finally boxed for shipment.

The men who use Hercules Explosives know how dependable are the men who *make* Hercules Explosives. The Explosives themselves tell the story. Their power never fails those who seek its aid. In metal mine and stone quarry, at the bottoms of deep rivers and in the hearts of great mountains, where the engineer builds a city skyscraper and where the farmer blasts a ditch, Hercules Explosives live up to the name they bear.

**HERCULES POWDER CO.**

| | | |
|---|---|---|
| Chicago | St. Louis | New York |
| Pittsburg, Kan. | Denver | Hazleton, Pa. |
| San Francisco | Salt Lake City | Joplin |
| Chattanooga | Pittsburgh, Pa. | Wilmington, Del. |

*As its name suggests, Gelatin Dynamite is plastic. It is made by dissolving gun cotton in nitroglycerin and combining with certain other materials called "dopes". It is used principally for shooting in hard rock.


# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.*

### Pertaining to Aeronautics

AERIAL BOMB.—G. E. COOK, 45 Tehama St., Brooklyn, N. Y. This bomb is particularly designed to be dropped from an airplane, dirigible or other aircraft, and to explode on striking an object. It consists of a body provided with a large number of explosive shells containing shrapnel or the like, which shells explode before reaching the ground, thus rendering the bomb exceedingly destructive.

### Pertaining to Apparel

WAISTBAND.—BERTHA CLARK, 342 50th St., Brooklyn, N. Y. This improved waistband for skirts, petticoats and similar garments is arranged to enable a dressmaker to readily lengthen or shorten the waistband to suit the waist size of the garment on which it is to be used. Another object is to permit of stiffening the band after attachment to prevent the waistband from crumpling when the garment is used.

FASTENER.—J. P. BURKE, Box 125, Struthers, Ohio. The present invention comprises a fastener of ball and socket type especially adapted for use on garments. The device is made up in whole, or for its major portion, of wire. It possesses the advantage that it can be made very small and inconspicuous and it may be rendered practically invisible when colored to suit the fabric to which it is applied.

SHIRT.—H. H. HERST, Ocean View, Va. Mr. Herst's invention relates more particularly to men's outer shirts, and its object is to provide a novel construction in connection with the front portion of the shirt to conceal and hold the flowing ends of four-in-hand ties. The upper and inner portions of the front of the shirt are cut away to form a V-shaped outlet, and special provision is made to insure the retention of the shape of this outlet in laundering.

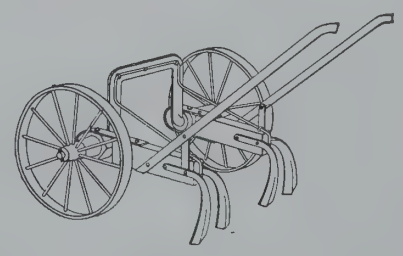
### Electrical Devices

THERMAL CIRCUIT CLOSER. — C. E. WIREN, 1637 61st St., Brooklyn, N. Y. An object of the invention is to design a bearing and journal indicating and protecting device capable of warning against continuing the operation of a bearing of machinery when said bearing is nearing the danger point of over-heating and approaching the point of destruction due to lack of lubrication. The invention provides means for closing an electrical circuit adapted to ring a bell or light an electric bulb light to warn against continued operation.

POWER GENERATING SYSTEM.—G. YANACOPOULOS, 541 E. 169th St., New York, N. Y. This invention relates to a power generating system and has for an object the provision of a construction wherein wind is utilized for compressing air to act as motive power for producing electrical current or for other purposes. A further object is the provision of a system whereby electrical energy may be produced and stored, the power necessary for the production being secured through a system of related machines for converting the power of the wind into a driving member for the generating dynamo.

### Of Interest to Farmers

CULTIVATOR.—H. C. SMITH, Clintonville, Conn. This invention relates to cultivators and has for an object the provision of a cultivator in which the cultivating members are resiliently held at a definite distance from



A PERSPECTIVE VIEW OF THE CULTIVATOR

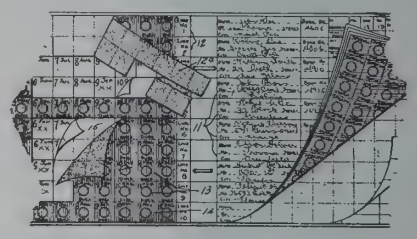
the row of vegetables being cultivated, this distance being easily varied, the resilient means consisting of a spring mounted on an arched axle having integral arms extending downwardly and rearwardly.

CULTIVATOR.—R. L. GUTHRIE, R. 3, Box 409, Santa Rosa, Cal. More particularly this invention relates to cultivators of the wheeled type, an object being to provide a cultivator which will be capable of a wide range of adjustment and which is relatively light so as to be easily moved over the ground. A further object is to provide a cultivator which may be utilized either as a pulling or pushing device, and which permits the plow standards and adjacent parts to be swung up out of the way and suspended on the handle.

FARM GATE.—T. HOUSTON, 202 Citizens Bank Bldg., Kokomo, Ind. The purpose of this invention is to provide a simple and inexpensive farm gate having means for holding one end of the gate in suspension, such means being adjustable to vary the height of the gate so as to permit the ready opening thereof under adverse conditions, such as when snow accumulates beneath the gate.

### Of General Interest

ACCOUNT BOOK.—A. HEISTERKAMP, 517 Garden St., Hoboken, N. J. This account book is particularly adapted for the use of societies and other organizations to enable inexperienced persons to keep an accurate record of all transactions. On one page are entered the names and addresses of members

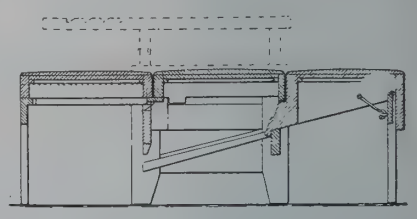


AN ACCOUNT BOOK FOR SOCIETIES AND ORGANIZATIONS

and on the opposite page, similarly ruled, are numbered spaces divided by perforations into series of stamps. Below this page is a wax page representing periods when dues to the organization are to be paid. As the dues are paid, the stamps are removed and pasted in a pass-book of the member.

IRONING SUPPORT.—S. E. DURANT, 176 W. 137th St., New York, N. Y. The object of the invention is to provide an ironing support more especially designed for ironing or pressing open-ended neckties, scarfs and similar neckwear, and arranged to permit convenient insertion of the support into either end of the neckwear to hold the same in propor position for an effective ironing or pressing.

CHAIR BED.—W. E. ESLHENBRENNER, 440 E. 143rd St., New York, N. Y. The invention provides an arm chair of the type commonly known as the Morris chair. The adjustable back which may be lowered into alinement with the chair



CHAIR CONVERTED INTO A BED

seat has a section under the seat which may be drawn out into alinement with the seat thus converting the chair into a bed of comfortable length.

PIGMENT-POWDER FOR MAKING SMEAR-PROOF IMPRESSIONS.—S. M. MCMURRAY, 54 Arcade, Nashville, Tenn. The object of the invention is to provide a pigment powder to be used in connection with an ink, such as printers' ink, or stamp pad ink, to bring out or intensify the impression made with the ink and also to render the impression resistant to the action of gasoline.

CUTTING BLOCK.—C. F. CONNOR, 23 Florence St., Marlboro, Mass. The invention pertains more particularly to a method of securing the several sections of a cutting block together. The prime object is to provide side and end bars by which the several parts making up the block may be securely clamped together, each of the bars being provided with nuts by which the bars are tightened into place.

FISH AND CRAB TRAP.—C. W. MUELLER, 1094 Summit Ave., Jersey City, N. J. An object of the invention is to provide a collapsible form of fish and crab trap which is convenient in transportation from place to

place. A particular feature relates to a folding frame on which the netting is applied. This permits the owner of the trap to adequately fold it up until it assumes a compact single one-piece package. The device has few parts, is strong and durable.

STATIONERY APPLIANCE.—E. P. Beckwith, Garrison, N. Y. The object of this invention is to construct an appliance which is more particularly intended to be used in connection with stationery and by means of which it will be possible to almost entirely eradicate creases from papers and particularly from blue prints without in the slightest affecting the same.

HANDLE FOR HANDBAGS.—N. Sloane, 228 Roebling St., Brooklyn, N. Y. The general object of the invention is to provide a handle combining a rigid arm-receiving ring with a flexible element adapted to connect the same in a novel manner with the bag frame so that the two jointly form a handle possessing advantages in the secure carrying and handling of the bag.

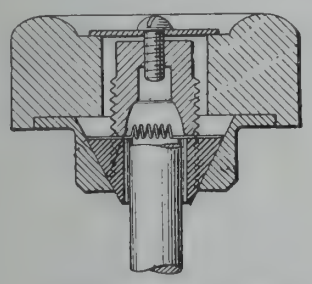
CAN SPOUT.—H. H. Shaw, Cambria, Cal. The invention relates to a device adapted to be inserted in a can, such as an evaporated milk can, by driving into the head thereof to thereby constitute a spout for the pouring of the contents from the can as desired. The device may be driven into the can by pressure or a blow of the hand, thereby obviating the necessity of any tool to deliver the driving blow against the spout.

DRIP WATER SAFE.—J. J. Hickey, 2138 Lexington Ave., New York, N. Y. The invention has particular reference to plumbing apparatus associated particularly with ice boxes, refrigerators or the like for private residences or apartment houses. An object being to provide a device to catch the drip from a refrigerator and direct the same into any suitable drainage pipe or system, and is particularly adapted for use in apartment houses and the like obviating the necessity of a removable drip pan.

WHEEL BEARING FOR FURNITURE.—R. J. Ehlers, Northport, L. I., N. Y. The object of the invention is to provide a wheel bearing more especially designed for use on bassinets, cribs, beds and other pieces of furniture intended to be wheeled about; the said wheel bearing is arranged to permit of quickly mounting the wheels on the piece of furniture without requiring skilled labor and to insure easy running without danger of wabbling or bending. The device is simple and durable in construction.

### Hardware and Tools

VALVE-HANDLE.—W. S. Neil, Minot, No. Dak. The frequency with which valve handles are broken and the fact that valves then cannot be controlled except with a "Stillson"



DETACHABLE VALVE HANDLE

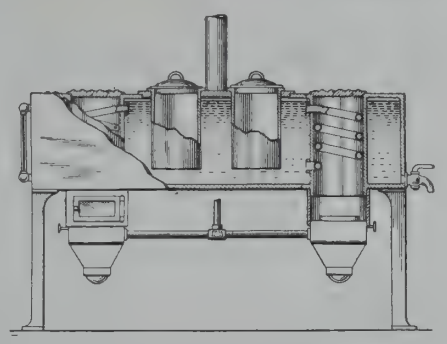
wrench, have led the inventor to provide a valve handle which will fit any size of valve stem and be affixed thereto as a permanent factor, or in case of emergency be quickly detached therefrom and applied to another valve stem of different size.

DRILL AND WIRE GAGE.—R. Ichiba, 136 W. 109th St., c/o C. Gorch, New York, N. Y. An object of the invention is to provide a caliper gage which may be readily applied to twist drills, wire of all kinds, and rods, for calipering the size thereof and for permitting the mechanic to read the drill or wire size directly from the graduated scale of the caliper. A particular object is to provide a precision instrument with a set of lettered size graduations upon one side and a set of numbered graduations on the other.

ADJUSTABLE AND RELEASING GUARD FOR SLICING KNIVES.—C. H. Krapf, 423 3rd St., Brooklyn, N. Y. The object of this invention is to provide an adjustable and releasing guard for a slicing knife arranged to permit the user to cut slices of bread, meat or the like of any devised thickness, and to readily release the slice at the option of the user. Another object is to enable the user to remove the cut slice and deposit it in another place without touching the slice.

### Heating and Lighting

STOVE.—B. H. Dickson and J. E. Frey, Yuma, Col. This stove is adapted to function as a cooking unit and also as an efficient hot-



A CROSS SECTION SHOWING ARRANGEMENT OF THE PARTS

water heater for cooking. The cooking of the food may be started on a dry burner and then be transferred to a receptacle which extends into the hot water reservoir.

HYDROCARBON BURNER.—A. Kaufman, 402 E. 53rd St., New York, N. Y. This invention has special reference to burners for kerosene or the like calculated for the development of an intense heat of a satisfactory and safe nature and with a minimum expenditure of fuel. The important object of the invention is to provide a simple and safe means for generating a maximum amount of heat from kerosene or similar oils relying especially upon the mixture of gasses delivered direct from the oils with a much larger amount of oxygen than is ordinarily experienced.

### Machines and Mechanical Devices

SHEET GUIDE FOR PRINTING PRESSES.—C. F. Huneycutt, Box 965, Charlotte, N. C. An object of the invention is to provide a movable sheet guide particularly adapted for use with bed-and-platen presses of the Gordon type in which the guides will engage with the sheets as they are fed to the platen, influence them to proper positions for impression and leave the impression surface of the platen immediately prior to the act of impression with the sheets maintained in proper position by the gage ordinarily provided.

FLEXIBLE COUPLING.—J. C. Sheler and R. B. Austin, 310 Marble St., Cadillac, Mich. The invention refers more particularly to a shaft coupling provided with a plurality of flexible joints so that power may be transmitted from one shaft to another at different angles. Another object is to provide a coupling which will transmit power at an angle thereto so that the driven shaft will rotate noiselessly, smoothly and without vibration.

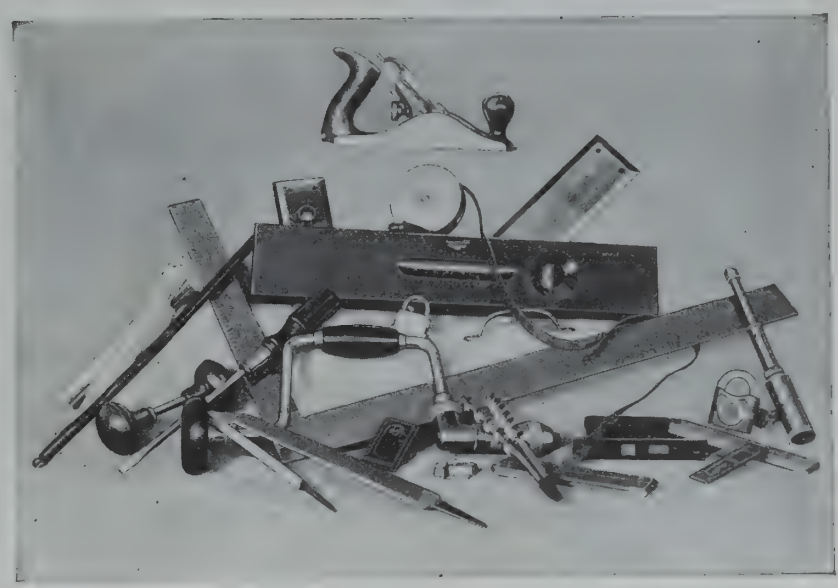
DUPLICATING MACHINE.—H. Cohn, 1060 Madison Ave., Albany, N. Y. This machine is arranged to print at each revolution of the printing drum not only the body of the letter but the heading as well. The heading appears as printed by inked type and the body as printed in imitation of typewritten work.

SHOE SHINING MACHINE.—C. Caldes, 22 Rutgers Ave., Jersey City, N. J. By means of this invention a single attendant in a shoe-shining parlor may operate more than one machine, regulating the machines to stop when the proper amount of brushing or other work is done. The brushes are arranged to move back and forth on the diffeernt parts of the shoe either automatically or under manual control.

PEARL BUTTON MACHINE.—P. F. Dusha and A. Feyk, address Holub-Dusha Co., 1797 1st Ave., New York, N. Y. This machine is particularly adapted for making buttons of the type known as shank buttons and is an improvement on patent No. 1,182,660. Special means are provided for preventing the drill from bending and from breaking or splitting the shanks while they are being drilled.

MACHINE FOR MAKING BUTTER.—J. A. Sheare, The Esplanade, Henley Beach, State of South Australia, Australia. This machine for churning cream into butter comprises a receptacle arranged to revolve in a circular path while at the same time it receives an oscillatin motion. By this means the contents of the receptacle are subjected to a violent agitation and the cream is churned into butter in a very short time.

TAKE UP STOP MOTION.—H. R. Bauer and H. F. Reinhold, 60 Clifton Ave., Clifton, N. J. An object of the invention is to provide a take-up stop motion for power looms, arranged to prevent the formation of a defective fabric by rendering the take-up inoperative and thereby preventing it from advancing the woven fabric in case the filling or weft

# Opportunity Beckons from the Mid-West

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*Dye stuffs*
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*Automobile accessories and parts*
*Drop forge plants*
*Tanneries and leather products*
*Malleable iron castings*
*Farm implements*
*Rubber products*
*Screw machine products*
*Locomotive works*
*Blast furnaces*
*Cork products*
*Small hardware*

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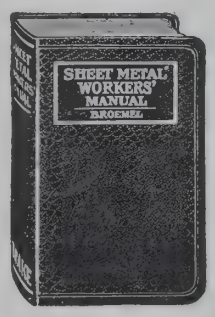


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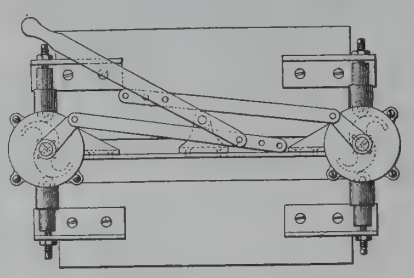
threads breaks or runs out in the shuttle. Another object is to enable the weaver to quickly make necessary repairs and to prevent the restarting of the loom unless the stop motion is first reset.

MOLDING MACHINE.—A. DIEHL, c/o Geo. B. Smith, 407 Bushnell Bldg., Springfield, Ohio. An improvement in molding machines is provided by this invention. A simple me-



IMPROVED MOLDING MACHINE

chanism is employed for simultaneously lifting the cope and the match plate from the drag. The lifting mechanism is operated by a single lever under the control of the operator and the parts are held parallel during the separation.

TEST VALVE.—G. ERNST, 44 Oakland Terrace, Newark, N. J. It is customay in high tension steam boilers to provide a number of test valves in order to determine the accuracy of the water level in the gage glass. As these valves are liable to get out of order, Mr. Ernst has provided a special form of test valve which is claimed to be absolutely dependable.

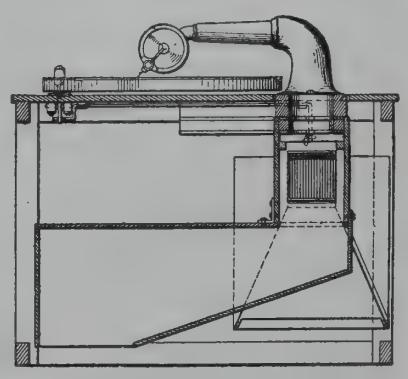
SLUB CATCHER.—F. WEBER, 148 Montana Ave., Union Course, L. I., N. Y. The invention comprises a device designed to prevent the passage of slubs, knots and the like which are formed on thread, cord, yarn, etc., and which prevent the proper passage of the cord through the eye of a needle or through weaving or knitting mechanisms of any sort.

FLEXIBLE COUPLING.—W. L. FRANCKE, New Brunswick, N. J. This invention is an improvement on previous patent No. 1,029,355, granted to Mr. Francke. The coupling is arranged to prevent undue bending of the shims on starting the driven shaft and to maintain the full power of transmission when started. The coupling is housed to prevent extraneous matter from impairing the action of the flexible members.

SEWING MACHINE GAGE.—S. MORGAN and S. HOFFMAN. Address Stanley Gerson, c/o Usona Shirt Co., 801 Broadway, New York, N. Y. In order to facilitate the sewing of buttons on garments, means are provided to do away with the preliminary measuring and marking of the garments. This results in a great saving of time and expense over the previous method of locating the position of the buttons.

### Musical Devices

PHONOGRAPH.—H. GUILBERT, 317 W. Center St., Provo, Utah. The object of the invention is to provide a sound amplifying means which practically eliminates the metallic sounds of the needle on the record and reproduces the finest of tones and sounds. A



A VIEW IN TRANSVERSE SECTION

further object is to provide a phonograph having a sounding board and mounting for the tone arm which is located under and connected to the central portion of the sounding board and which also carries a horn or horns to amplify the sound.

REPEATING DEVICE FOR SOUND REPRODUCING MACHINES.—E. PEREMI, 329 Union St., Brooklyn, N. Y. In connection with phonographs employed for the purpose of teaching a foreign language, this invention provides a means for repeating a particular word, sentence or any small portion of the record whenever desired. The device may be attached to a phonograph without requiring any alteration in the construction of the machine.

### Railways and Their Accessories

PERMUTATION LOCK.—J. P. GERACHTY, 493 Grove St., Jersey City, N. J. This lock is designed particularly for use on railroad car doors, trunks and other devices, and is arranged to allow ready inspection of the car seal with a view of determining whether the lock has been tampered with while the car is in transit.

### Pertaining to Recreation

AMUSEMENT DEVICE.—JACOB IRSCH, 351 Jackson Ave., Long Island City, N. Y. This amusement device is in the nature of a globe bicycle race with both the globe and the bicycle rider moving at a speed in proportion to the speed of movement of the operator. The object is to provide a number of racing figures on bicycles with manually actuated devices for driving them and an automatic disconnecting device for cutting off the driving devices when operated at too high a speed.

### Pertaining to Vehicles

TIRE.—W. H. MCGOWEN, 16 No. 12th St., Vincennes, Ind. The invention has for its object to provide a tire having a resiliency approximating that of a pneumatic tire, without the faults, in that the tire is not subject to blowouts from punctures. The device comprises a filler for tires in the form of an annular hollow support gradually increasing in width from its outer face toward its inner face, a series of arched springs connected with the support and a shoe enclosing the support.

RESILIENT WHEEL.—H. C. ANDERSON, 2461 Fresby Ave., Westchester, N. Y. The invention has for its object the formation of a wheel which possesses all the resilient qualities of a wheel having a pneumatic tire. Another object is to provide what is the equivalent of a pneumatic hub for a wheel whereby the pneumatic cushioning means are so placed and guarded as to be practically indestructible in so far as traction or contact with the ground are concerned.

RESILIENT TIRE.—F. PERDALA, c/o John Soiko, 91 Titchenor Ave., Newark, N. J. The object of this invention is to reduce puncturing of the inner tube to a minimum. The tire is arranged to produce a desired cushionng effect and permt of readily removing a worn out tread from the shoe and replacing it by a new one without requiring removal of the shoe from the wheel rim.

AUTOMOBILE BUMPER.—F. KAMMITTER, 9 Henry St., New York, N. Y. The invention has reference more particularly to an automobile bumper of the flat spring type. An object is to provide a bumper which is secured to the bumper supports by a plurality of spring members so that in case of a breakage of one of the members during a collision the remaining members will still support the bumper and prevent damage to the automobile.

RESILIENT WHEEL.—A. JIMENEZ, 413 W. 156th St., New York, N. Y. The invention contemplates the provision of a wheel in which the movable parts are entirely exposed so that they may be readily cleaned, in which no more oil is required than the usual chassis springs and in which, no matter how caked with mud, or other matter, the parts will always operate positively. The resilient effect is produced by means of apparatus located between the ends of supporting members extending between the axle and the lower part of the rim, and the rim itself.

### Designs

DESIGN FOR A FAN.—C. M. LEVETT, 507 W. 186th St., New York, N. Y.

DESIGN FOR A HEAD RING FOR ELECTRIC LIGHT FIXTURES.—H. SHLAMOWITZ, 3914 12th Ave., Brooklyn, N. Y.

DESIGN FOR A RUBBER SHOE PLATE.—D. H. ELEY and T. H. RYAN, 323 Board of Trade Bldg., Norfolk, Va.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## The Third Degree for the Baseball

(*Continued from page 219*)

standing considerable stretching, these qualifications adapting them for use as baseball covers. The horsehide covers are sewed on the balls when wet and as they dry they shrink and tighten on the balls so that when ready for service they are as tight as the bark on the tree. Fabric covers are not suitable as baseball overcoats because they lack in resiliency, stretching ability and durability.

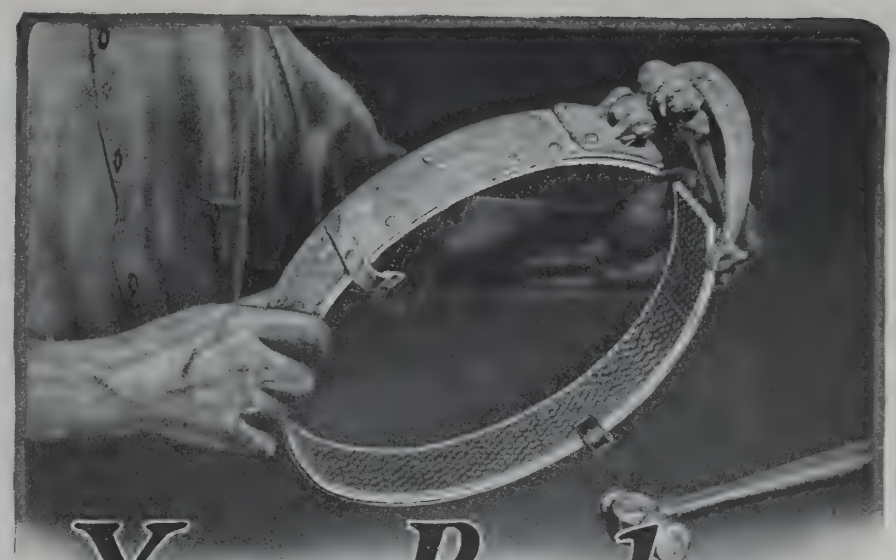
During the war the Government wished to purchase many thousand baseballs for the use of the soldiers both at home and abroad. Six different factories offered samples and bid on these huge contracts. The War Department submitted the matter of selecting the best balls from the samples offered to the National Bureau of Standards which as a result inaugurated the first baseball efficiency tests ever attempted. It was impossible at the time to subject all the baseballs to performance tests on the actual field of play. Hence laboratory methods for the determination of the durability, wearability, adaptability and efficiency of the balls were devised.

All the balls were first subjected to rebound tests to determine their resiliency. Each ball was dropped on a wooden plate from a carefully measured height, the rebound in each instance being accurately measured and the average of five rebounds being accepted as the official test figure for each ball. Subsequently the balls were all run through a tumbler machine similar to that used in foundries to scale the dirt from castings, which subjected the covers of the balls to friction and abrasion test.

A hook 1/16 of an inch in diameter was then slipped under a stitch in each of the ball covers and the force necessary to rip the stitch out of place was ascertained. In all cases it was determined that, invariably, the stitches would break before the leather would tear. Then the double lacings used to sew the cover of the ball were removed and their tensile strength was determined on special machines for that purpose. The leather covers were cut into strips one inch in width and tested for tensile strength and elongation.

Subsequently the ball interiors were thoroughly dissected and the qualities, color and strength of the string and yarns were ascertained while the character of the windings was carefully studied. The best balls were found to have rubber cores surrounded by continuous windings of good quality yarn with a thin layer of cotton thread on the outside of the ball. Some of the inferior balls were wound with only about 50 per cent of good wool while the balance was cheaper material which was not as durable. Most of the balls contained from two to four different windings of woolen yarn. The percentage of wool used ranged from 50 to 83 while the percentage of cotton thread varied from 0 to 21. Some of the balls contained no sizing—a chemical substance like glue or potato starch which is added to the wool and cotton windings to make them sticky. The rubber cores were also subjected to rebound tests while their powers to resist pressure and their compactness were also determined.

When the balls were dropped a distance of five feet the range of rebound varied from 28 to 29.5 inches while where the drop was ten feet, the rebound ran from 48 to 52.5 inches. The composite weights of the balls varied from 140 to 144 grams indicating that the weight corresponded closely in all instances to the official standard. Measured in terms of the different component parts, the weights were distributed in this wise: lacing cord, 1 to 1.6 grams; first winding, 4.8 to 10.3 grams; second winding, 15.5 to 27.8 grams; third winding, 16.5 to 23 grams; fourth winding, 31 to 54 grams; leather cover, 23 to 30 grams; rubber

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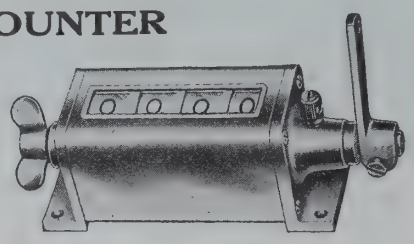
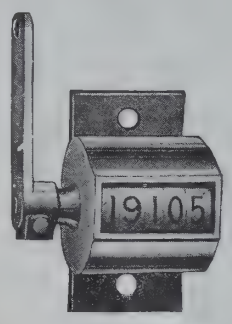
*The large Set-Back Revolution Counter at right is ½ actual size. The small Revolution Counter below is shown nearly full size.*






The Set-Back Revolution Counter above records the output of the larger machines where the revolution of a shaft registers an operation. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, according to purpose. Price, with four figures. as illustrated, $10.00 (subject to discount).

The Small Revolution Counter at left records the output of smaller machines where a shaft-revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

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center, 22 to 29 grams; sizing, 0 to 7 grams.

The tensile strength tests showed that the baseballs, in the main, were designed for rough and ready service. The tensile strength of the lacing cord ranged from 27 to 46 pounds per strand as it was pulled from the ball. After the balls were dismembered, the tensile strength of the laces varied from 7.1 to 11.4 pounds per strand. The yarn of the first winding had a strength range of from 0.8 to 3 pounds per strand; that of the second, 0.8 to 4 pounds; the third, 1 to 2.8 pounds and the fourth, 0.95 to 4.4 pounds per strand. The tensile strength of the leather cover varied between 48 and 85.9 pounds per square inch while the stretch of the leather ran from 26.5 to 42 per cent. A 15-ounce load applied to the rubber centers through a disk of the same radius of curvature as the rubber cores resulted in a compressibility of from .003 to .008 of an inch. When dropped 58 inches the rubber cores rebounded distances of from 47 to 48 inches, indicating extreme liveliness and resiliency.

As a result of these tests, the sample balls submitted were divided into three classes. The balls which qualified in the first class were purchased by the War Department and shipped in enormous quantity overseas and to army camps in this country. The efficiency of these balls under actual playing conditions was high and the consensus of evidence indicates that the unique laboratory trials originated by Uncle Sam's experts to determine the comparative value of different makes of balls were extremely efficacious.

### Handling High Voltage with Bare Hands

(*Continued from page 219*)

The safety staging is about 90 per cent wood and has no capacity, so that as soon as the man's body takes its charge, there is no further sensation.

The designer of this ingenious safety staging guarantees satisfactory results up to 110,000 volts and states that this limit will soon be extended. Insulators can be tested and changed and the entire pole top rebuilt, if desired. Switches may be cut in, arms changed, slack cut out, heavy lines tapped; in fact, any job which has ever been done on a 2,300-volt line can now be done on the higher voltages under full load.

A few of the advantages claimed for this new method are: The man is placed in a position where he can work easily and naturally with his hands, which would not be possible otherwise unless the current were turned off. The quality of the work done is equal to or better than that done on a "dead" line with a platform to stand on. The men are said to be far better safeguarded than would be the case in working on lower voltages from the pole, with rubber gloves.

### Muggy Days and Air Thirst

(*Continued from page 220*)

water vapor per unit volume is 4.7 grams, while at the latter there are 9.3 grams present or nearly twice the amount.

To add to our bewilderment a locality may have a lower humidity than another and yet be damper. Who would imagine that on a winter morning Boston with a mean humidity of 73 per cent would yet be drier than Yuma with a humidity of 56 per cent at the corresponding hour? Yet it is so, and the Arizona city has three times the quantity of water vapor present at the Hub.

Always in considering relative humidity the temperature and the prevailing wind must be taken into account.

It would be a great boon to physicians if some reliable index of the air thirst in different localities could be given them; a table of *true* relative humidities, one in which the water vapor present was


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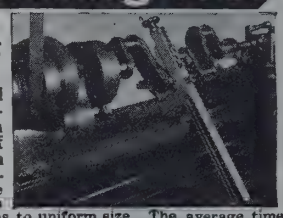

This Weber Tool turns all pins absolutely round from one setting of Crank Shaft, on centers. A micrometer dial enables the operator to gauge his cuts and turn all pins to uniform size. The average time required for trueing up one pin is from 5 to 10 minutes. The 4 pins can easily be finished in 30 minutes, and the entire shaft is completed with only one setting.

**The Weber Tool is guaranteed** to turn crank-pins within as close limits of accuracy as any other known method. It will soon save its cost in any Tractor or Automobile Repair Shop. An assortment of cutting tools are furnished. These will fit the pins of most of the popular automobiles, trucks and tractors. Write for Circular and Prices.

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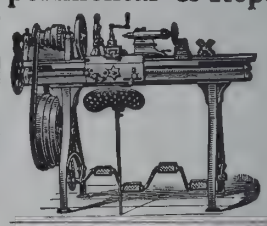

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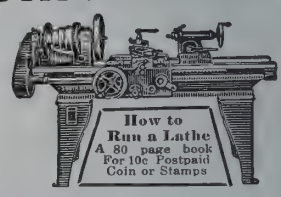


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compared with standard values for definite weather conditions.

### Keeping the Human Engine Cool

And as for these muggy days, these days which are the exact opposites of Castilian days, we know that, to quote from an old Spanish proverb "No wise man will argue with his friend" on such a day. For we are all "touchy." We are fretful, not entirely because the day is warm; a succeeding day may be even warmer and the sense of uneasiness less.

The explanation lies in the degree of air thirst. On a muggy day, the thermometer may read 1,112 on the new Absolute Scale, i. e. 87 degrees Fahrenheit. The relative humidity or ratio of vapor pressures is high, say 90 per cent. It is a day when the best humored fat men become somewhat cynical. One perspires freely but the perspiration must be wiped away, for it does not evaporate.

Next day the temperature may be higher, perhaps 1,120, or 91 degrees Fahrenheit but if the relative humidity is 65, due possibly to a light northwest wind, then one is fairly comfortable notwithstanding the added heat. There is actually less water vapor, the amount being 20 grams as against 30 on the muggy day. As we perspire we reduce the skin temperature 22 grads, while on the muggy day we could not cool more than 6 grads. Small wonder that we fan vigorously on muggy days and "fuss" because the fanning is not more effective.

On a warm day or in a crowded, heated room, we feel "stuffy" because we one and all load space with water vapor, respiring as well as perspiring; and the thirst of space for water vapor is soon satisfied. Our bodies are heat engines, driven by internal combustion of food; and we readily become heated. If we had indicator gages we could watch the moisture and temperature rise; and just as soon as these passed certain critical values, our feelings of discomfort and irritability would become evident.

It is the effort to adjust ourselves to new requirement which makes us uneasy. We are fighting to keep a balance between heat developed within, heat thrust upon us, and heat expended. It is important to keep warm enough to be comfortable, but equally important to keep cool enough to be comfortable; and this last during the dog days is best accomplished by efficient skin action, and the vaporization of sweat. A dry dog day facilitates this; a damp dog day makes it difficult or even impossible.

## Where Willow Ware Comes From

(*Continued from page 222*)

the spacing recommended by Uncle Sam for purple willow, plants are set 6 by 30, 9 by 30, or 12 by 30 inches.

The first two years is the critical period for the young plants. Where the cuttings are closely spaced, hand hoeing must be practiced as often as necessary to keep the weeds in check while where wide spacing is pursued a horse can be used to perform this work. Cultivation must be thorough but it should never be deeper than 2 to 3 inches. Where cultivation is properly practised and where the spacing of the plants is correct, it is almost impossible for the obnoxious weeds to gain a foothold. Frequent and regular inspection of the willow tract is essential in order that the owner may stamp out and control such pests as morning glory vines, caterpillars and dodder whenever they appear.

It is inadvisable to neglect spots where plants fail as all such places should be replanted the same year in which they develop. Where such spots are neglected for long periods it is very difficult ultimately to set out replants which will live and flourish. Usually the replants should be set out each season after the willows have been cut over at harvest time, in order to give them an early start. The replants should be allowed to grow for two seasons without cutting and then should be cut back to the original size of the second season plants as otherwise they will shade the older, established plants.

Generally, the willow should be cut before the buds begin to swell as late cutting after the growth has started in the spring restricts the output of the succeeding crop, while it also retards the new growth. Willow rods that are to be steam-peeled may be harvested as soon as the leaves fall and the wood has matured. Rods which are to be sap-peeled or used for cuttings should not be removed until December or January unless satisfactory storage facilities are available. Usually, the ordinary hook knife is the best tool for cutting willow rods as where pruners are used it takes from one-third to one-half more time to perform the work. Stools should be cut as low as possible as practical experience has demonstrated that the best longtime results obtain where this method is followed. Under labor conditions which existed previous to the war, the average cost of cutting willow rods ranged from $10 to $15 an acre where the yield did not exceed two to three tons green weight.

As soon as possible after cutting, the rods should be bundled according to size and shape, either binder twine or small willow rods being used. After the leaves appear in the spring, the rods have to be kept in water until peeled as otherwise they die and then it is impossible to remove the bark. For this reason the rods are kept in pits where the water is deep enough to cover the ends of all the rods, the willow crop being kept upright in such pits until time for peeling arrives. The difficulty of securing labor which will properly peel the rods by drawing them between two steel plates or bars which have spring enough to break but which do not crush the wood is often the limiting factor in basket willow culture. The industry would be vastly benefited by the invention of a practical peeling machine which would eliminate this costly hand labor expense.

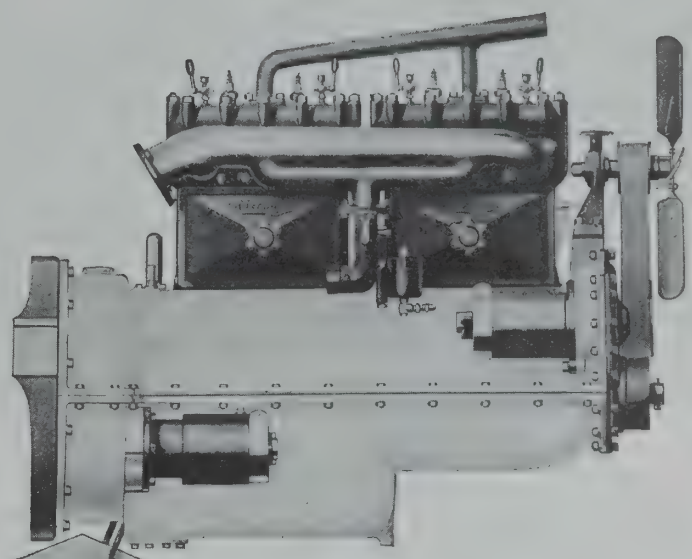
Experts maintain that the fact that most of the American-grown willow is steam-peeled is disadvantageous to the trade in general as it lowers the market quality of the rods and also centralizes the industry in the hands of a few dealers instead of under the control of the small growers and basket makers. After being peeled the rods should be dried thoroughly for one to two days in the hot sun before being bundled. It is necessary to cover them at night and during rainy weather as, otherwise, the rods lose their whiteness. Usually, the preferable time for sorting the rods is during the peeling process.

Ordinarily the income from the basket willow farm does not amount to much until the third year but henceforward up to the fifteenth season the average annual net profit per acre should range from $85 to $100. Abroad, willow baskets are used exclusively, hampers of all grades and quality being made from willow. In America, pine, oak, ash, elm, reed and rattan baskets are on the market in competition with willow to such an extent that a dependable and profitable market exists for only the finest grade of fancy willow baskets. On this account the bulk of the American willow supply is used in the manufacture of furniture.

## The Heavens in September, 1920

(*Continued from page 224*)

be easy to see. Mars is past quadrature, and is an evening star, setting about 9:30 p. m., standard time, in the middle of the month. Jupiter is a morning star, rising from one to two hours before the sun. Saturn is in conjunction with the sun on the 7th, and practically invisible. Uranus is in Aquarius, and is visible all the evening. Neptune is a morning star in Cancer, inconvenient to observe.

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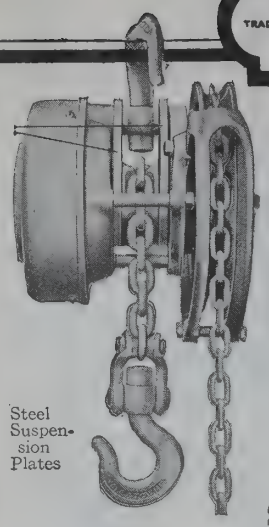


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The moon is in her last quarter on the 5th at 2 p. m., new on the 12th at 8 a. m., in her first quarter on the 19th at midnight, and full on the 27th at 9 p. m. (eastern standard time). She is nearest the earth on the 8th and farthest away on the 20th. As she circles around the zodiac, she passes near Neptune on the 9th, Jupiter on the 11th, Saturn and Mercury on the 12th, Venus on the 13th, Mars on the 18th, and Uranus on the 25th—none of the observable conjunctions being close.

At 3:29 a. m. on the 23rd, the sun crosses the celestial equator and enters the "sign" of Libra; and, as the almanacs say, "Autumn commences."

Clark's Island, Plymouth, Mass.
August 20, 1920.

## A Forward Step in American Airplane Engines

(*Continued from page 226*)

There are 12 cylinders of 5¾-inch bore and 6½-inch stroke, and 2 banks of 6 cylinders forming a Vee with an included angle of 60°. Two inlet and two exhaust valves are used for each cylinder, each valve port being 2 inches in diameter. Each pair of valves is operated by a duplex rocker arm, working in conjunction with a single cam. Two spark plugs are used per cylinder and thanks to the clean "alley" between the cylinders, are notably accessible, not requiring the use of a special wrench. The ignition current is supplied by an improved battery system which is arranged in duplicate. The distributor heads are fixed in place and the spark advance is obtained with a slidably controlled drive shaft.

The engine complete weighs 1,118 pounds and in its initial test delivered 578 hp. at 1,920 r.p.m. or 1.94 lb. per b.h.p., as against an average of 2 to 2¼ lb. per b.h.p. in the best of the war-time engines. This can be considered a very satisfactory performance in view of the fact that the engine went through its initial test in exactly the condition received from the assembly department and without any modifications. Gasoline consumption was at the rate of .52 lb. per b.h.p. hr. for maximum power carburetor setting and .45 lb. per b.h.p. hr. for maximum economy carburetor setting. Oil consumption was at the rate of .025 lbs. per b.h.p. hr. which also represents a remarkably good economy.

It is evident that an engine of this type has a wide range of usefulness due to its rugged design in combination with comparatively light weight. For use with a flying boat, heavily loaded commercial or war plane, a flying speed of say 80 m.p.h. corresponding to 1,275 to 1,350 r.p.m. of the engine with an output of 400 to 420 hp. could be maintained and this would undoubtedly allow of 250 flying hours without overhauling the engine. If run at somewhat higher speed, say 1,500 r.p.m., the engine is capable of developing about 475 hp. and would be eminently suitable for long distance work at comparatively high speed, say 100 to 120 m.p.h. such as would be required for a bombing plane in war time or a mail plane in peace time. If it was desired to utilize all the power the engine is capable of developing, a light low-resistance plane could be designed around this engine which would have some startling speed possibilities far in excess of anything yet accomplished.

It is to general commercial uses, however, rather than to employment in war or in racing, that I look for the greatest value of this engine. Since America is not and never will be a military nation, aviation cannot hope for adequate development through appropriations for naval or military purposes. Yet until we are in a position to dominate the air above our country in case of emergency, America will not be safe.

The only answer to this problem is the development of commercial aeronautics. I believe that America is now second to none in the matter of engine design, except possibly in air-cooled fixed radials, and though we are not so far advanced in plane design, we can lay claim to having originated most of the ideas used in airplanes today all over the world, and I am convinced that if we can make a business of aeronautics, thus putting it on a sound financial basis, we have the talent and the facilities to lead the world.

## This Year's Nominations for the Hall of Fame

(*Continued from page 226*)

bronze tablet and put up in the corridor of the Hall. If Hunt is elected this year there will be two tablets each crediting a different person with the invention of the sewing machine.

It is claimed that Hunt invented a machine for sewing which was provided with an eye in the point of the needle and a shuttle in 1834-1835, which was more than ten years before Elias Howe obtained a patent for a sewing machine. Among other inventions of Walter Hunt is the paper collar, the safety-pin, a repeating rifle and pistol, a forest saw with lever for cutting and felling trees, an improved kerosene lamp, a fountain pen, an improved stopper for bottles, etc.

The inventors elected to the Hall of Fame in previous elections and whose names are already inscribed on bronze tablets in the Hall are Robert Fulton, inventor of the steamboat; Samuel Finley Breese Morse, inventor of the telegraph; Eli Whitney, inventor of the cotton gin; and Elias Howe, inventor of the sewing machine. Howe was elected in the last election, 1915. The others were all elected in the year 1900 at the first election when the Hall of Fame was built and inaugurated.

The ten scientists whose names appear on the 1920 ballot are Benjamin Thompson, Matthew Fontaine Maury, Benjamin Pierce, Nathaniel Bowditch, Spencer Fullerton Baird, Benjamin Silliman, Josiah Willard Gibbs, Samuel Pierpont Langley, Henry Lewis Morgan, and Simon Newcomb. The four latter are new nominations this year, while the former six have been voted upon in every election since and including 1900.

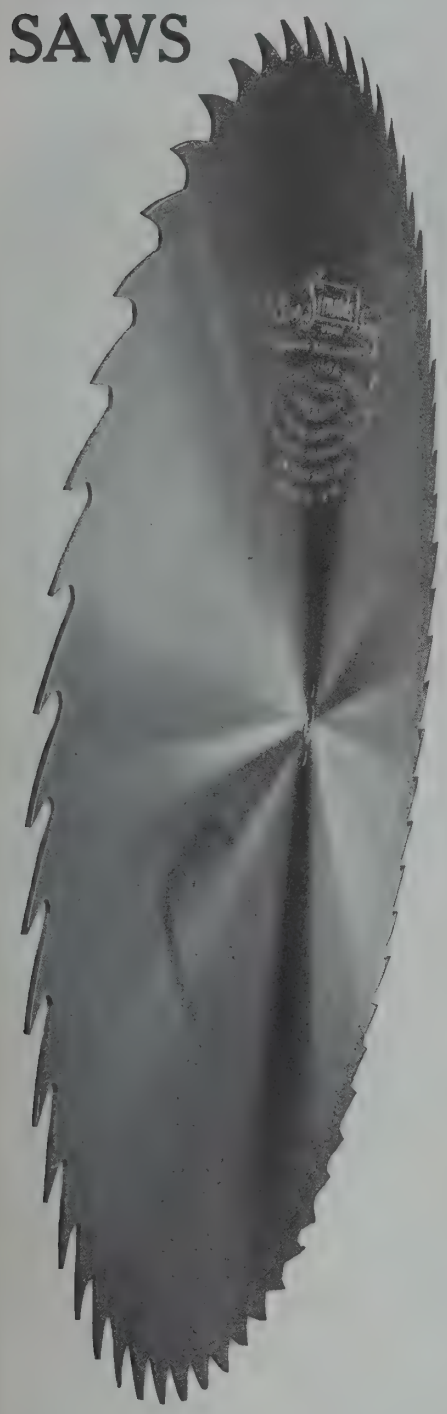
The scientists already elected and whose names are on tablets in the Hall are John James Audubon, Asa Gray, Louis Agassiz and Joseph Henry. The two latter were enrolled in 1915, while Audubon and Gray were elected in 1900.

There are two inventors whose names appear on the ballot this year but not under the classification of Inventors. One is William T. G. Morton, the dentist who invented anaesthesia and an apparatus for its administration. Dr. Morton is on the ballot under the classification of Physicians and Surgeons. He received a large vote in the elections of 1910 and 1915 and it is likely that he will this year be elected. Dr. Morton, of course, properly belongs under the classification of Inventors. The other inventor who, quite properly, appears in the class of Authors, is Thomas Paine, author of "Common Sense," "Rights of Man" and "Age of Reason." Thomas Paine invented the iron bridge, the planing machine, the hollow candle (which is the principle of the modern central draught burner), etc.

The new nominations on the final ballot now in the hands of the 102 electors to the Hall of Fame are the nominations that were selected by the various groups that considered the names submitted on the preliminary ballot about one month ago. Many names were discarded altogether on the preliminary ballot. Only those names which were approved by a majority of the electors in the various classes achieved a position on the final ballot.

The group which passed upon the names of inventors and scientists is com-

# SIMONDS CIRCULAR SAWS



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The 102 electors to the Hall of Fame are persons of distinction in various professions and are located in all sections of the country. These electors are listed in seven groups as follows: Actual or Former University or College Presidents, Historians and Professors of History, Scientists, Authors and Editors, Men and Women of Affairs, Actual or Former High Public Officials, Actual or Former Justices, National or State.

There are "vacancies" in the Hall of Fame to be filled this year by the names of twenty men and ten women—if elected. It is unlikely that more than a dozen men and five women will be given a vote large enough to secure their admission to the Hall.

## Smothering Fire with Bubbles of Gas

*(Continued from page 228)*

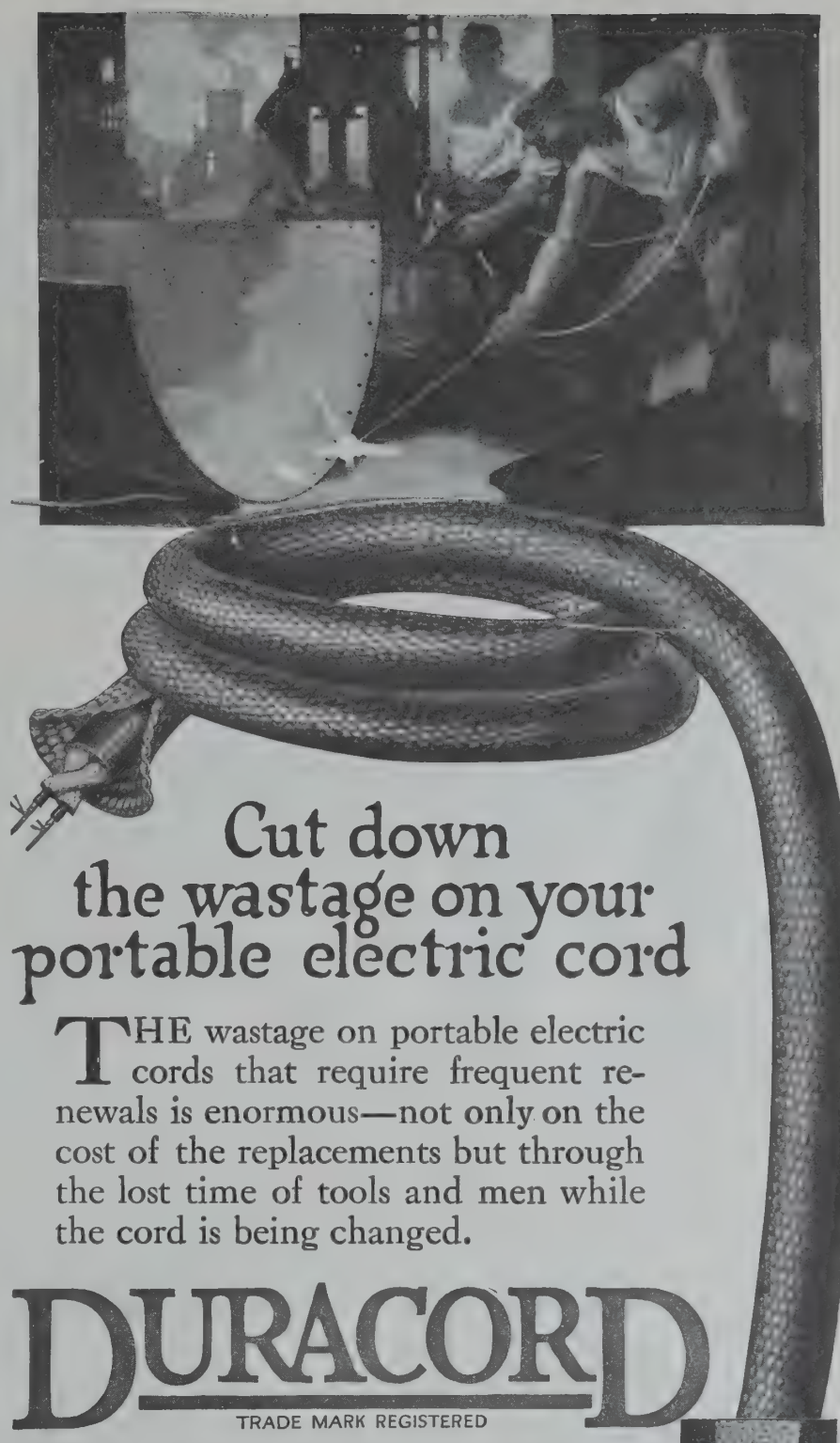
dioxide will naturally have disappeared. There will remain, however, a curious mass distributed over the area which will consist largely of the sodium sulfate and the aluminum hydroxide shown at the right of the equation, or modifications of these.

It is not so long that the world has known exactly what is the thing we call *fire*. But, in 1786, the great Lavoisier revealed the truth in a single sentence: "Fire is the combination of a substance with oxygen." When the suds made as indicated is thrown onto blazing oil, it contains practically nothing that will combine with oxygen. The sodium sulfate, the aluminum hydroxide and the carbon dioxide, all, are chemical combinations already heavily loaded with oxygen. In so far as the oxygen of the air is concerned, the blanket of bubbles cares nothing for it. In so far as the oil is concerned, the bubbles hold on to their oxygen. The result is that the blanket does not feed the flame in any way. It acts principally as a shield, protecting the oil from the atmospheric oxygen.

The manner in which oil tanks are protected is, in general, as follows. The two solutions are separately kept in suitable containers at some suitable central station. Metal tubes are laid along the ground, or buried in it, from the containers to mixing chambers attached to the several oil tanks. These open on the surface of the oil at their upper ends. The solutions are, upon occasion, pumped through a double line of piping extending from the pumping plant to the tank, each solution along its own line. At the mixing chamber, the two mingle. The quick formation of the carbon dioxide at this point is competent to eject the suds as it forms. Where a considerable number of tanks are connected up with one station, the piping may be arranged so as to avoid the installation of a distinct complete double line of pipes for each and every tank. By the use of valves, certain branches may be cut off and others brought in; so that a complete double line will exist for the particular tank on fire.

The volumes of the two solutions required are equal. It is necessary then that the arrangements be such that equal deliveries are made at the mixing chamber. The twin duplex pump or the flywheel pump are approved types for the purpose. It is understood that the ordinary duplex pump is liable to be ineffective because of short-stroking.

The amount of foam or suds required for an oil fire will naturally vary with the character of the conflagration. Usually, a quart of each of the two solutions per square foot of surface will when mixed and converted into suds be competent to

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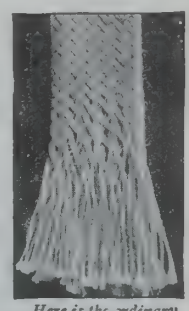
*This is Duracord. Thick, heavy strands, woven like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.*



*Here is the ordinary braided cable covering. Note the open and porous construction, easily cut, stretched or unraveled. Compare it with the illustration of Duracord above.*

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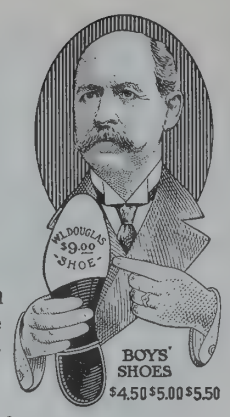


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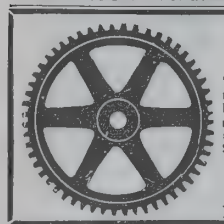

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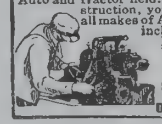

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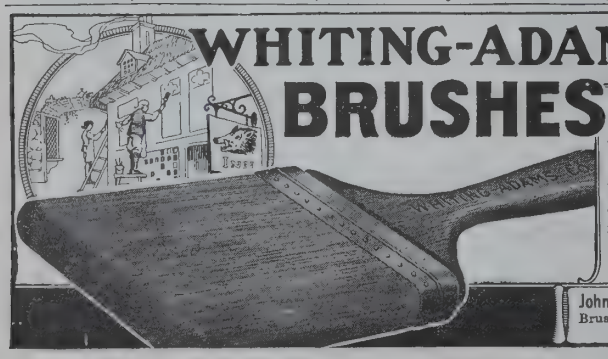

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put out almost any fire. Often, half this amount will be sufficient. A good sized oil tank having a diameter of 100 feet can be covered with suds in from 5 to 10 minutes, if a proper size of twin duplex pump is employed and the arrangements are otherwise what they should be. Each of the two solutions should be available in amounts of 600 barrels. The pipe lines to the tank should be of the 3-inch size and two mixing chambers should be provided on the tank. Arrangements may be made for discharging the foam from a nozzle.

Naturally, a substance usable for the quick extinction of oil fires may be employed to put out fires in general.

The development of the mechanical apparatus for the quick generation and utilization of fire-suds is an important side of things. Here American genius has played its part, as well as in connection with the perfecting of the process. Mr. O. R. Erwin has been and is one of the leaders in inventive matters. Many of his experiments have been conducted on a considerable scale. Thus, a considerable trench would be flooded with oil and the whole made the means of testing some phase of the practical development of the suds idea. Then there are others whose names have not been brought to the fore, but whose participation in the forward movement has been valuable. The whole development from the first germinal thoughts would seem to fall within a space of about a score of years.

## Latest Patent Decisions

*(Continued from page 229)*

include a successful structure. Claims should cover what the patentee has invented, and nothing more. The plaintiff has failed to establish infringement.—*Whitlock Coil Pipe Co. v. Mayo Radiator Co. U. S. D. C. of Conn.*

**Different Means to One End:**—Suit in equity by Harry B. Ross against Overlin & Jameson. Complainant sues to enjoin infringement of its patent for improvement in motor trucks. Complainant's motor truck is adapted for picking up lumber disposed in piles; and transporting it in and about saw-mill and lumber yards, and depositing it at places of destination. The process is to drive over or straddle a lumber pile, pick it up, or raise it, by means of the motor used for propelling the motor truck, and, thus suspended beneath the frame of the truck, carry the same and deposit it where needed. Defendant Overlin has devised a motor truck of similar construction, designed to perform the same service and has secured a patent, also, on his machine. Complainant alleges infringement. Held, no infringement for, while Overlin's machine lifts, carries and deposits piles of lumber, it does not do so by the same mechanism as the complainant's truck, the lack being a principal horizontal beam, or a compound structure acting as a beam, receiving vertical load, and bearing vertically upon its supports.—*Ross v. East Side Mill & Lumber Co. U. S. D. C. of Oregon.*

**Jurisdiction over Contracts:**—The bill in this issue alleges that the plaintiff was the inventor of a useful invention in steam traps, and that by an instrument in writing he granted unto the defendant company the sole and exclusive right to manufacture and sell the apparatus—that he was to receive $100 within six months and $5 upon each apparatus sold by said company until he had received the sum of $1,800 in royalties. The bill further alleges that the defendants have sold a large number of steam traps covered by the patent, and on which royalties have accrued and have not been paid.

The motion to dismiss the bill must be granted. While there is a diversity of citizenship, the amount involves less than $3,000. The action is one for breach of contract and in no way involves a determination of whether the patent has been infringed. The bill is dismissed, holding as a matter of law, that a suit for accounting for royalties under a contract granting an exclusive license to manufacture a patented device is not one arising under the patent laws, and where the sum involved is less than $3,000, a federal court is without jurisdiction.—*Odell v. F. C. Farnsworth Co. U. S. D. C. of N. Y.*

## Is the Dam Safe?

ENGINEERING literature is replete with examples of failures of structures traceable to inadequate knowledge on the part of the designer relating to the pressure exerted by the earth against these engineering feats. All of which magnifies the tremendous possibilites of this soil-pressure measuring device, and a series of experiments being conducted simultaneously by the U. S. Bureau of Public Roads and the Miami Conservancy District. The study of slumping in these five earth dams assumes this attitude of a wide core in hydraulic dams: Caving of the banks inward; extension of the soft core by the production of movable material in the banks; and, finally a bursting out of the core either causing or caused by a slip of the weakened bank.

Consequently, in the construction of this quintette of flood-protecting dams the central cores are to be nowhere wider than the final dam height. Such an observance necessitates that the hydraulicing be conducted with a narrow pool, affording an ample section of stable, coarse material on either side. This proves practical if the finest portions in the materials are reduced to a suitably low percentage or if the surface drain from the pool is handled in a fashion to insure the disposition of excess fines. The resulting cone, with side slopes of approximately 1:2, is thought sufficiently wide for compactness and not favorable to induce caving of the bank along the contact. The base width of the core is only slightly in excess of 100 feet in any of the five dams, which is usually less than one-fifth of the dam base. The enlarged width of the outside bank is a source of additional strength.

Percentages of gravel, sand and clay present in the usable material have been determined by investigations, disclosing to engineers the available borrowpits most nearly approaching the requirements for desirable proportions of coarse and fine materials for dam construction. Frequent analyses of core materials are made.

As a precaution of avoiding an excess percentage of fine materials in the core, th mechanical analysis of the pumped material has been so clearly defined as to limit both the percentage of core materials in the total, and the percentage of silt and clay in this fraction. The core percentage is fixed by the cross-section of the dam. Limitation of fines in the core material is determined largely by the results of pressure measurements, as revealed by the soil pressure measuring instruments. The pressure measurements thus far indicate that the material in the cores of these dams is assuming a solid condition.

Resistance to penetration or the supporting power of the cores of the five dams is being determined by lowering a 6-inch cast-iron ball into the pool by a rope, its penetration under weight being recorded. The soil-pressure measuring instrument will doubtless reflect dependable information as to the lateral pressure existing in hydraulic dam cores, and determine the relation of vertical to horizontal pressures. Unpretentious in size and appearance, the device has immense possibilities, and it is not a remote objective for mechanical ingenuity to even outwit what is sometimes considered the fates of floods and misfortune.

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**POWDER**
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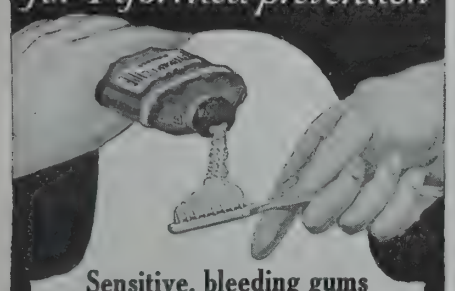

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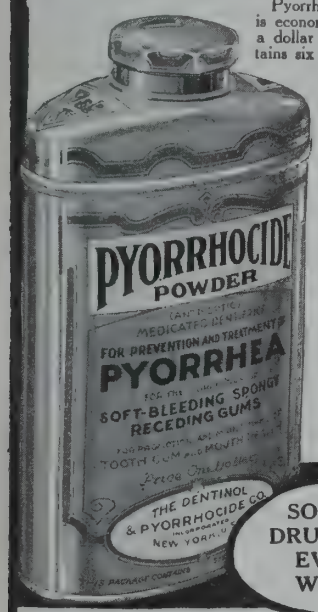


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## Notes and Queries.

**Kindly keep your queries on separate sheets of paper when corresponding about such matters as patents, subscriptions, books, etc. This will greatly facilitate answering your questions, as in many cases they have to be referred to experts. The full name and address should be given on every sheet. No attention will be paid to unsigned queries. Full hints to Correspondents are printed from time to time and will be mailed on request. Please write your queries; do not telephone them, please.**

(14342) C. M. asks: I am writing to ask you for information in regard to insulating magnetism. Is it true that magnetism will penetrate any substance? Can you refer me to a treatise upon the subject? A. Magnetism penetrates nearly all substances with the same ease as it passes through the air. Iron, steel and a few other metals it penetrates with more ease than it penetrates air. It is evident from this statement that magnetism cannot be kept out of substances by ordinary insulation as electricity can be. The only way of insulating a substance from magnetism is to provide an easier path for the magnetism. This is done by surrounding this substance by iron since as we said above magnetism penetrates iron more easily than it does most substances. An iron box will screen its contents from magnetism. The iron should be at least a half inch thick for the best protection. You will find statements on this topic in text books. We do not know any treatise on the subject. It is called permeability.

(14343) H. A. B. asks: I have put up in my yard a sun dial. I got the directions from a copy of the Women's Home Companion, published in Springfield. That article said to find the latitude my place was in, and follow a table they gave, which I did. This place is West Liberty, Ohio, is in latitude 40°. They said to make the "gnomen" that casts the shadow 6 11/16 in. high and see to it that the noon mark, 12 o'clock, is pointed exactly north. Now what I want to ask you is this: If the pointer casts a shadow directly north and south isn't it noon at that place? A. Your question, which seems very simple, is far from actually being a simple question. If a sundial is set correctly so that the gnomon stands exactly north and south the sun at midday will be exactly in the plane of the gnomon and the shadow will fall on 12 of the dial. It is the middle of the time between sunrise and sunset—midday—but not twelve o'clock local time, the true time of your place, except on four days in the year, about April 15, June 14, September 1, and December 24. The dates vary a day or so because of our calendar, in which an extra day is inserted in February in leap years. The difference between the sundial and the local time is called the Equation of Time, of which you should have a table furnished with the dial. Correct the sundial reading for the equation of time and you will have your local time. But your place probably uses central standard time, which is six hours behind Greenwich time, the time of the 90th meridian. To set your clock by the sundial you will require your longitude west of Greenwich. This changed to time gives you your relation to central standard time. Subtract your longitude in time from 6 hours and you have the difference between your local time and central standard time. With these numbers you can set your clock by the sundial reading. Proceed as follows: To the sundial reading add or subtract the equation of time for the day. This gives you your local mean time. To this add the difference between your longitude in time and 6 hours. The result is central standard time, the time to which you will set your clock.

(14344) H. J. S. asks: Scientists and geologists have long stated that as the crusts of the earth cooled earthquakes would become less frequent and in time disappear. The exact reverse of this is now however the case with 468 recorded in 1919. Some of these have been very destructive to life and property and have been scattered throughout the world and are still continuing. Had they occurred during the war it would have been logical to suppose that the huge mine explosions had effected the stability of the strata. Christ said that famines and pestilences and earthquakes in divers places would be signs of His second coming. I do not understand geology so request that you give me a scientific or geological reason for these disturbances

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and if the formation of North America is such that there would be no danger of quakes away from the western coast. A. The great earthquakes are mostly from one of two causes—the shrinking of the earth due largely to cooling, or the effects of volcanic action. Both of these effects must persist so long as the causes are active. In the long future both causes will cease to be active, and earthquakes must cease. But no scientist would say in years when that time will come. Certainly not in our time. Geology reckons time in thousands and in millions of years, and earthquakes now occur by the thousands each year. It is estimated that there are 30,000 earthquakes a year which are large enough to be perceived by the senses, and an almost innumerable number of lesser tremors which are too small to be perceived. Among these smaller earth tremors would be placed the mine explosions to which you refer. Such an explosion however does not jar the earth for any considerable distance. The great explosion of many tons of high explosives in Hell Gate, New York Harbor, many years ago, was recorded on seismographs for only about 200 miles, a very short distance compared with the distance to which a real earthquake shock is transmitted. Most of our earthquakes are due to the cooling of the earth and the shrinkage of its strata from cooling. The result is the breaking, folding, and slipping of the strata upon each other. A slip of but a short distance will produce a large effect upon buildings and the earth's surface. A motion of a fifth of an inch, it is said, will throw chimneys down. The greater part of the United States seems to be free from violent earthquakes, but in the past there have been great earthquakes in several regions. In 1811-1812 a series was felt in the lower Mississippi Valley, which has been characterized as "of world-shaking order." The last considerable earthquake in the East was the Charleston earthquake in 1886. These facts seem to indicate that severe shocks are not as common as a century and more ago. The great earthquake regions of the earth lie in two circles, one surrounding the Pacific Ocean and the other lying nearly east and west around the earth through the Mediterranean, southern Asia, the East and the West Indies. If you would have a good discussion of this subject we would advise you to get Tarr's College Physiography in which you will find about 100 pages devoted to it.

## NEW BOOKS, ETC.

THE MODEL T FORD CAR. By Victor W. Page, M.S.A.E. New York: The Norman W. Henley Publishing Co., 1920. 8vo.; 410 pp. 153 illustrations.

The thoroughness and lucidity of this writer's instruction books are readily acknowledged by the army of students and readers which profits by them. This enlarged and revised edition of his work on the Ford car deals also with truck and tractor conversion sets, the Fordson farm tractor, and the F. A. lighting and starting system. Its multitudinous diagrams and photographs of actual parts are all in correct proportion, and materially assist the student in grasping details of construction, operation and repair. It is practical experience reduced to black and white—just such concrete facts as owners and drivers, dealers and repairmen should know.

UTILISATION DES ALGUES MARINES. By Camille Sauvageau. Paris: Librarie Octave Doin, 1920. 12mo.; 394 pp.; 26 illustrations.

Seaweed furnishes many valuable products. Potash, iodine, and adhesives are obtained from it; it is in use as a fertilizer, as food for animals, and even as food for man. M. Sauvageau, at the invitation of the *Direction des Inventions*, has given us an instructive work on French and foreign marine algae and the methods by which they are made to serve useful purposes, including American processes. He enumerates medical uses and gives the species used as bait by fishermen, while the identification of varieties is aided by numerous drawings.

A LAWYER'S LIFE ON TWO CONTINENTS. By Wallis Nash. 12mo.; 211 pp.; illustrated. Richard G. Badger, The Gorham Press, Boston.

Each phase of the experience, here so entertainingly set forth, covers some forty years of an extremely active life. The author relinguished a lucrative practice to assume the vice-presidency of a pioneer western railroad, the Oregon Pacific. Wallis Nash, throughout his long and busy life, has been a keen and discriminating observer of men and things; he writes with a facile pen and every page of these reminiscences is full of interest. Particularly so are the pen sketches of notable men with whom he was in close professional and social touch during his life in London. Thus, it was his good fortune for many years to be a neighbor and intimate friend of Charles Darwin. Speaking of Darwin's almost uncanny memory, he records how he went to Darwin's study and consulted him about a certain bug that was working havoc among his grapevines. "Go upstairs," said Darwin to his son Frank "and on the third shelf from the top of the left-hand book case you will find the journal for 18— of such a German Etymological Society. About page 257, on the right of the book and midway down, I think you will find the description of the insect and its life's history." And there or thereabouts we found it. It fell to Wallis Nash to handle the Bell patents in Great Britain, and he describes Bell as being in the 70's, a "tall, black-haired, handsome and very attractive man of thirty." At a meeting of the Society of Arts, he writes "the young lecturer made a very excellent impression; his effective and pleasantly modulated voice reached every person present." He speaks of playing Beethoven to Herbert Spencer "who sat by the piano and talked of the connection between brain and hand and eye in the interpretation of music." Another friend was Sir John Lubbock, and another the great Bessemer, who would talk freely of his early struggles, when funds were so low that even his wife's wedding ring was sacrificed—this on the eve of his final success.

AUTOMOBILE STARTING, LIGHTING AND IGNITION. By Victor W. Pagé, M.E. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 815 pp.; 492 engravings.

This is an enlarged, revised edition of a deservedly popular work by an author whose name is a synonym for the very best in automobile instruction. The repairman has to handle a wide variety of ignition systems; each variety, with its failures and their remedies, is made plain to him here. Elementary electric starter principles, and typical starting and lighting systems, their faults and the speedy location of them, are dealt with in the thorough fashion for which the writer is famous; there is a chapter on the design of electrical measuring instruments and their use in testing; the whole is prefaced by a chapter on elementary electricity, and every detail is opened to the eye by means of clean-cut figures, plates and diagrams.

AN INTRODUCTION TO THE STUDY OF CYTOLOGY. By L. Doncaster, Sc.D., F.R.S. New York: G. P. Putnam's Sons, 1920. 8vo.; 280 pp.; 31 figures, 24 plates.

The writer believes that cytological investigation is one of the most promising leads toward biological advance; his work, of wider scope than the text book, not only gives the important facts of animal cytology, but indicates how research in this branch is bound up with great fundamental problems. Careful selection is necessary to so condensed a treatment, and on the whole this has been successfully accomplished. The book describes the cell and cell phenomena, discusses accepted theories, and touches upon the mechanism of hereditary transmission and the rôle of the cytoplasm.

LUCK ON THE WING. By Elmer Haslett, Major, Air Service, U.S.A. New York: E. P. Dutton and Company, 1920. 8vo.; 303 pp.; 8 plates.

The humorous and the dramatic alternate through these stories of a sky spy. As Gen. William Mitchell points out in his laudatory introduction, the book has a double value: it is a truthful, gripping picture of the life of our air fighters during the great actions of Chateau-Thierry, St. Mihiel, and the Argonne; and it plainly shows how the lack of understanding of the functions of the Air Service resulted in the dissatisfaction that prevailed. Hilarious incidents mark the writer's capture and incarceration, and the stories are as well worth reading for their humor as for their information.

EXPERIMENTAL ORGANIC CHEMISTRY. By Augustus P. West, Ph.D. Yonkers-on-Hudson, New York: World Book Company, 1920. 8vo.; 469 pp.; illustrated.

In this college textbook a well-known instructor embodies the method he has long successfully used in mimeographed form. One of its claims to attention is that it combines textbook and laboratory manual in one, with printed directions that permit the student to do his own work, thus at once saving the instructor's time and developing self-reliance in the pupil. Dangerous and difficult experiments are excluded, exactitude in the preparation of compounds is insisted upon, searching review questions follow each chapter, and there are numerous charts, diagrams, and structural formulæ.

IN THIS ISSUE:

WATER PIPES OF WOOD
SUCCEEDING IN SAFETY ENGINEERING

# SCIENTIFIC AMERICAN

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NEW YORK'S SKY-LINE ARTISANS: STRUCTURAL-IRON WORKERS

Vol. CXXIII. No. 11
September 11, 1920

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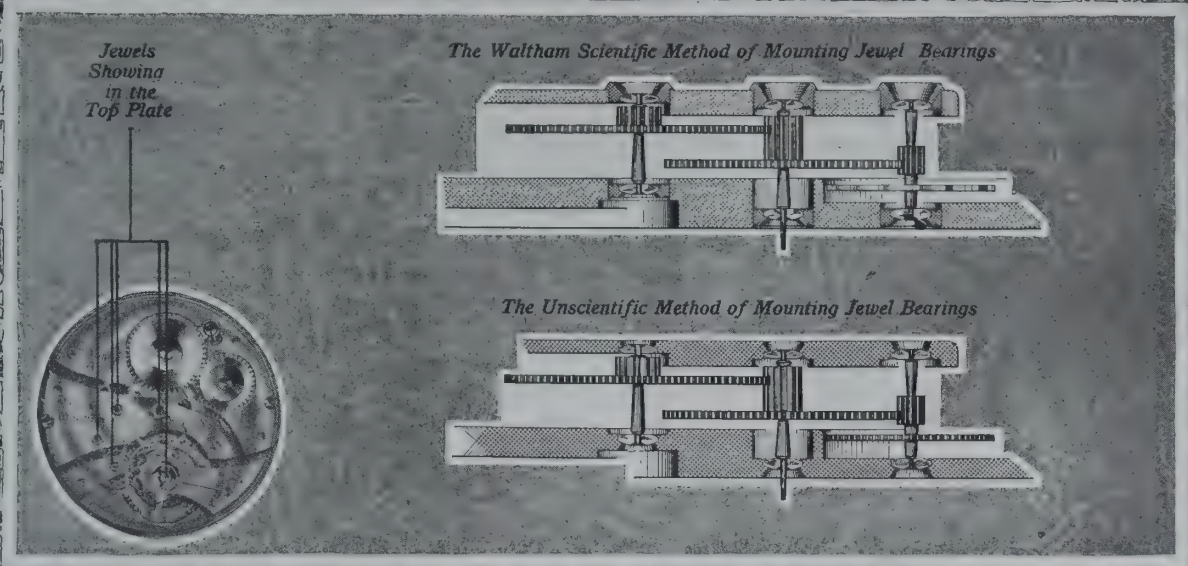


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So important was the necessity of securing the jewels rigidly in relation to their bearings (with the pivot hole exactly in the center and the jewel in perfect alignment with the plate and pivot so that the jewels could be removed easily for cleaning or repairing when injured) the Waltham Watch Company, after years of painstaking development, created a scientific method of jewel setting which made it easy for the jewels to be so removed and reset without affecting in any way the original time-keeping quality of the watch.

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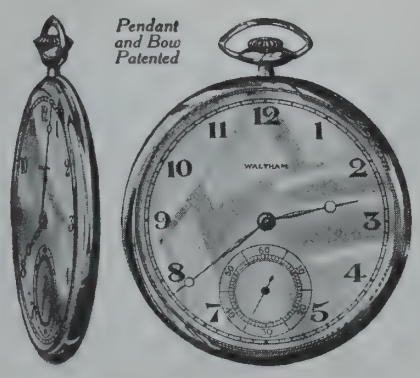
This is one more reason, in addition to many others of like value, why your watch selection should be a Waltham.

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Maximus movement 21 jewels
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# WALTHAM

THE WORLD'S WATCH OVER TIME


THE SCIENTIFIC AMERICAN. September 11, 1920. Volume 123, Number 11. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $5.00 per year.
Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

*Cleveland Museum of Art, Wade Park, Cleveland, Ohio. Hubbell & Benes, Architects*
*Covered with Johns-Manville Asbestos Built-Up Roofing.*

*Residence of Mr. G. Schrader, Pasadena, California, Roofed with Johns-Manville Asbestos Shingles.*

# Both these buildings have one virtue in common—an Asbestos Roof

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# JOHNS-MANVILLE
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SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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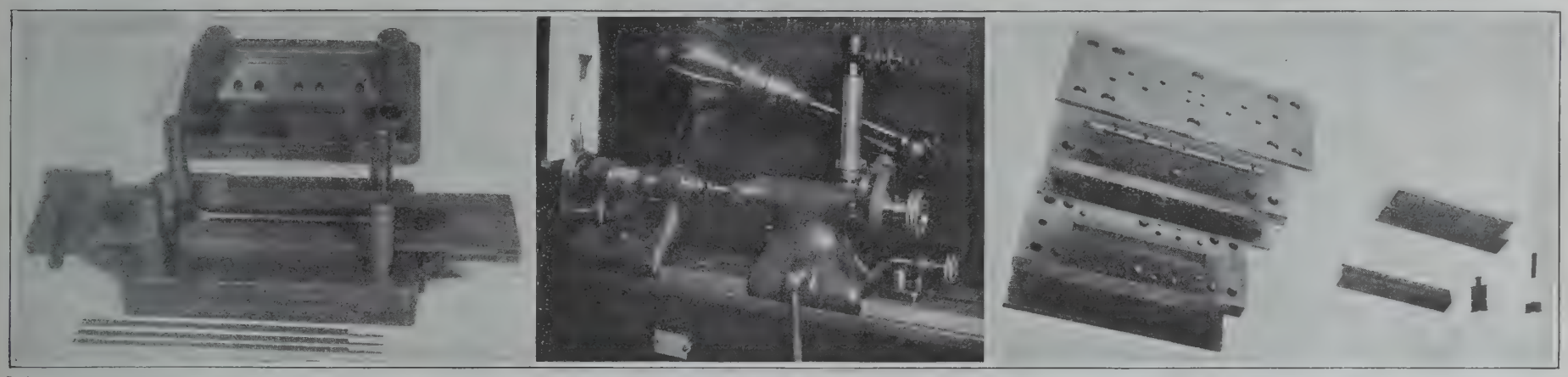

*Left:* An exceptionally accurate perforating punch-and-die used in turning out high-grade electrical apparatus. *Center:* A rather unusual assembly of an ordinary micrometer and a liquid gage that multiplies its measurements by more than a thousand. *Right:* The punch-and-die machine taken apart to show its internal construction.

**Some of the tools that are used to translate the hundred-thousandth of an inch into practice**

## Splitting Hairs With Close-Limit Tools

By Alfred Longville

WHEN is an inch not an inch? The question is not a brand new conundrum; it is asked in all seriousness. One would answer correctly by saying that 999 one-thousandths of an inch is not an inch. To the layman such a trifle as a ten-thousandth of an inch might not be of much moment. But in the making of tools which turn out certain electrical apparatus an inch isn't exactly an inch if it's even a hundredth of a hair too long or short.

What does the average person visualize by the term a ten-thousandth part of an inch? Said person might smile and say there is no such thing. It would not be missed off the end of a yardstick, might be the contention. Yet as certain as little drops of water go towards the making of an ocean, so would an inch disappear entirely if one continued to chop ten-thousandth parts of it away. The same would be true if one were to divide the ten-thousandth part by ten and make it a one hundred-thousandth part of an inch. To most minds an inch is small enough and any smaller dimension is hardly to be reckoned with. Yet as small as it is, if it were possible to slice an inch into one hundred thousand parts and slice off each part as rapidly as one can deal playing cards from off a deck, which is about four to a second, six hours, fifty-six minutes, and forty seconds would elapse before the last one hundred-thousandth of an inch was sliced off.

In order that one may get a better idea of a hundred-thousandth part of an inch, or even a ten-thousandth part of an inch, let one place one's imagination to the eye-piece of a compound microscope, under which there is a filament of some substance a ten-thousandth of an inch in diameter, side by side with a human hair of average size. Seen through the ordinary microscope, the hair would look about the size of a lead pencil. Yet the ten-thousandth of an inch filament, magnified to the same extent, would appear about as thick as the human hair.

If one by this time is able to imagine a tenth of what is left of that ten-thousandth part, after it is taken away from the microscope and does not appear magnified, one may begin to understand something about close-limit tools, one of which is a punch and die for perforating used to turn out certain electrical apparatus. This particular tool is composed of a certain number of similar sections, so nearly alike that their thickness does not differ as much as one thousandth part of an inch. And if one by this time has been able to imagine just what this minute measurement constitutes, one is no doubt awaiting with an amazed expression to learn just how any one can possibly determine whether an inch is exactly an inch or only 999 one-thousandth parts of an inch.

The ways of telling are diverse and interesting. When a tool-maker is at work on a given block he generally uses what he calls an "indicator gage." This gage consists of a flat disk on which the measured piece is placed, and a small cylindrical upper jaw, movable in a vertical direction. This upper jaw connects through a series of levers to a pointer, which moves over a scale. Owing to the leverage, this pointer moves about one-sixteenth of an inch for every ten-thousandth of an inch movement of the upper jaw. Therefore, with the upper jaw so set that the pointer will rest on the zero line when the standard adjusting block is in the gage, a practical tool-maker can compare another block with the standard without getting much over a hundred-thousandth of an inch error. To make sure of that hundred-thousandth the blocks are checked in a measuring machine in which the indicating jaw is connected to a liquid gage that multiplies 1,300 to one. This gage is simply a relatively large cylindrical chamber with a small-bore glass tube projecting from the top. The front of this chamber is closed by a flexible diaphragm, against which the far end of the indicating jaw rests. When this jaw is opened a small amount it pushes the diaphragm a little way into the chamber. Now, if the chamber is entirely filled with a liquid, this movement of the diaphragm will displace some of the liquid and force it up the small glass tube. Since a very small quantity of liquid goes a long way in a very small diameter tube, it is easy to see how such a gage can multiply the movement of the indicator jaw 1,300 times.

**A grinding machine that produces work accurately within the twenty-thousandth of an inch**

*Comparing* two lengths within a hundred-thousandth of an inch is no trick at all on this machine. But so little cannot be said of *getting* them to within a hundred-thousandth of an inch. The later stage comprises a series of tricks, to master all of which the most skilled tool workers would be hard put in a single life time. Because of this fact the tool-makers are specializing in their work.

Various operations, such as milling, lathe work, grinding, fitting, etc., are done by different groups in which men exceptionally good at one branch of their specialized sub-work keep at that sort of work exclusively. Because of this kind of specialization it is possible to build a tool as large as the perforating punch and die and at the same time get it within the degree of accuracy required. It would be possible to do so without this specialization, but the cost and the length of time involved in the completion of such a tool would be prohibitive by the methods used in most tool-making establishments. Outside tool-makers who have not specialized in this work declare that it is practically a commercial impossibility to make such a tool.

The commutator-strip perforating punch-and-die is built up of 50 punch sections, 50 die sections, and 50 shedder sections. Each punch section is exactly like every other punch section, each die section exactly like every other die section, and each shedder section exactly like every other shedder section, granting that one-hundred-thousandth of an inch is close enough to signify exactness.

The method by which the tool-maker makes them that way is peculiarly interesting. At first the parts are machined and ground to what the most exact person would term a high degree of accuracy. After this they are hardened, during which process a certain amount of distortion always occurs, following which they are submitted to the real job of being ground. They are ground to within five one-hundred-thousandths of the standard size, which constitutes a real job in grinding. It requires the very best of machines and the very best of operators, familiar with all of the idiosyncracies of their machines, to produce work of such accuracy. This job is better appreciated when

(*Continued on page 260*)

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Shifting Lines

THE definite profession of the engineer is of comparatively recent origin. There have, of course, always been men under whose eyes the work of the world has been done. The Roman highways, the bridge of boats that gave the Persian access to Europe, the pyramids, the great works of the Mesopotamian plain—all these called for what we recognize as engineering instincts and abilities in the conception, the planning and the execution. Even the early arts, like bow-making and pottery and boat construction, are examples of primitive engineering skill—the making of anything that comes out as it was intended to come out and that serves the purpose for which it was planned is engineering work. But throughout the prehistoric, ancient and medieval periods and well into the modern, the engineer was merely the boss artisan.

With the widening of human knowledge since, say, 1800, the effort to keep this corpus in order and to apply it to concrete cases as they arise has demanded a special profession. To meet this demand the engineer was created—or created himself; and he has been in existence long enough for us to get something of the historical viewpoint toward him. Various aspects of this viewpoint might be emphasized; the one that inspires these remarks has to do with the manner in which the vast field of the engineer was, and the manner in which it now is, subdivided. There has been here a significant shifting of lines.

Originally we had the civil and the mechanical and the electrical engineer. From the day when the engineer was first called on for evidences of specialization within his field, he followed one of these three directions. The first-named would apply his knowledge with equal facility to the laying out of a railroad or the surveying of a new country or the erection of a great bridge or the designing of a floor to carry a heavy load or the throwing of a dam across a stream or the location of the best highway between two given points. The second found it a matter of indifference what sort of a factory he was sent to, or what manner of machinery he was asked to install or maintain there. And the last-named was quite prepared to work in telegraphy today, in dynamos tomorrow, in street-car motors or trolley wires the next day, and in electrolysis next week. The engineering field was divided according to the raw materials of the engineer, and, so divided, it fell naturally into the three domains outlined—that of the engineer whose raw material is electricity, that of the one who does things with machines, and that of him who works with the static forces of the visible external world.

In the beginning of the profession this was altogether satisfactory. It has not remained so. The first sign of a break in the old scheme came early, with the segregation of the mining engineer as a distinct sort of animal. To qualify for this profession a man had to have some of the equipment of each of the three preexisting groups, but in none of these fields did he require complete training. The reason for building up this composite of the three existing branches and giving it a name and a standing of its own was the very excellent one that mining work called for all three types of service, yet made demands which it seemed should be possible for one man to meet. So the man arose to meet them, embodying in his own equipment the elements of the necessary coöperation between civil, electrical and mechanical engineering, making his own such parts of these three fields as he needed in his business and discarding the rest.

Eventually the process was repeated, not in one but in many instances. What it then came to was the regrouping of the engineers on a new basis. It would mean nothing today to claim to be a civil or a mechanical or an electrical engineer—it would give not the least information as to what the claimant was qualified for and what he was not. For today we have railroad-signal engineers and automotive engineers and safety engineers and marine engineers and turbine engineers and dock engineers and conveyor-belt engineers and magneto engineers and highway engineers and subway engineers—and a host of others which we have neither the time nor the space nor the patience to catalog. Each of these professions is distinguished from the others, not so much in what the incumbent has by way of technical equipment as in what he does with it. So the old division on a basis of raw materials has passed away, and today we catalog our engineers according to their finished products.

This is eminently sensible and eminently modern in viewpoint. Three thousand years ago it was natural and proper to group workers according to the material in which they worked. In those simple days a man was a mason or a carpenter or a weaver or an ironsmith or a coppersmith or silver-and-gold smith. At that date it would have been ridiculous to group the mason and the tent-maker together on the mere ground that both were engaged in the construction of human habitations. But with the multiplication of tools and of knowledge, it would be just as absurd to catalog a manufacturer of telephone wire and a photo-engraver in the same group on the mere ground that they both use copper as a raw material. We prefer to regard the wire maker as an industrial brother of the battery builder and the man who makes composition stands and mouthpieces, while we relate the photo-engraver with the compositor and the pressman—substituting a classification that follows the finished product for the one that follows the raw materials employed. So it is in the engineering field, and properly. Civilization weaves so complex a web of causes that we find it far easier to distinguish and identify results.

## When the Grim Specter Stalks

PLAGUES, we ordinarily think, are a thing of the past. Now and then we have isolated cases, even local epidemics on a small scale, of smallpox and the bubonic plage. But with the word "plague" we associate a phenomenon that is distinctly obsolete—the utter ravaging of whole countries and continents by a pandemic that is swift in its spread and high in its percentage of mortality.

The reason for this is of course that we know more than our ancestors did. Yet with all our knowledge, we are not free from plagues that, considering our improved ability to meet them, make away with a disgracefully large proportion of our numbers. The great plagues of history have been to all intents and purposes stamped out, and our success in achieving this end is attributable to the fact that every one of these plagues, with one exception, was transmitted through an intermediary agent. We can exterminate the rats and the mosquitoes, we can regulate the milk and water supply, by a simple exercise of the police power. Even in the case of smallpox, there is the almost certain prevention through the single, simple act of vaccination; and this, too, can be enforced through exercise of the police power.

But the plagues of today—the minor ones, such as scarlet fever, whooping cough and measles, or the major ones, such as influenza, pneumonia and tuberculosis—are transmitted in quite a different fashion, and require for their ultimate stamping out measures of quite a different character. They are independent of intermediate hosts and to a great extent of food and drink pollution. Their eradication depends not alone upon compulsory isolation of reported cases, but upon personal habits as well. Transmission is strictly through personal contact. Many of these maladies are transmitted during their early stages, before a diagnosis is possible and hence before specific protection against the individual carrier can be effected.

So where originally the health officer required merely the qualifications of a policeman, he must now add to these the training of an engineer and the abilities of an educator. The combination is doubtless a rare one; but to prevent the spread of disease all three of these functions must operate. The finger which goes to the nose and then to the doorknob must be restrained; the unguarded sneeze or cough in the public place must be made to yield to education. The offender must learn that he is restrained, not necessarily because of any belief that he is actually spreading disease—to the person of average good habits there is something particularly insulting about this suggestion, even when he realizes that he necessarily carries with him at all times a choice collection of the germs of all the standard diseases, which only await the opportunity to become active—but merely in the execution of a general policy. Even if we believe that a particular member of the community has no germs to spread, we cannot permit him to do things that are forbidden to those who may have such germs—we might as well allow respectable citizens to jimmy their way into locked houses just for the fun of so doing, and punish only those wielders of the burglarious tool whose intent can be proved felonious. The public at large must be educated to an understanding of the fact that its protection requires certain rules to be laid down for observance by everyone, without exception. When this viewpoint is general, and when the people at large have so thorough an understanding of health protection that adequate moral and financial support will be extended to the health administration, we may find that tuberculosis and influenza and pneumonia and scarlet fever are no more necessary concomitants of community life than were bubonic and typhoid.

## Greek Kakophony in the English Language

IT has been remarked that practically everything worth while in our modern civilization can be traced back to the influence of Greek antiquity. Far be it from us to say anything derogatory of our debt to the sages and poets of Hellas. But it is human to feel our little itching discomforts more than the solid blessings of life. So we cannot help wishing, sometimes, that our Greek heritage had come down to us without collecting an irksome tax; without inoculating upon our good old English tongue the germs of such philogical antics, as for example, *poikilotherm, enantiomorph, schizophrenia, epistemology,*—and, horror of horrors, such words as *syzygy* and *phthisis.*

Presumably we may charge this influx of uncouth aliens into our technical terminology, in the first instance, against the early classical scholars, who set the fashion since followed. Whether we owe them a debt of gratitude for this may be left undiscussed. But when we reflect upon the offense to tongue and ear which these verbal monstrosities commit, we are set wondering whether the lover of the dead languages has quite as fine an ear for euphony as he, no doubt, would have us believe. Perhaps enthusiasm has clouded better judgment. We recall, in that dim past when we were gracing the school bench with our (then) juvenile presence, how our revered classical master, one afternoon, held forth to us about the beauties of the Greek language. His remarks were pointed with a reading from Homer, which he rendered with fine fervor; totally oblivious of the fact that, had he been addressing a Greek audience he might, indeed, have made a lively impression upon their sense of humor, but certainly could have made little appeal to any other faculty. For scarcely a word would they have understood of the gibberish into which their words were distorted by his English pronunciation.

There they are now, firmly rooted in our native tongue, those words of foreign sound; refusing to fall into the natural cadence of our speech; shuffling along in the procession of our discourse as the limping, the lame and the halt in a gay parade. Uncouth, incongruous, they stand out against the sober background of language like the offending patch in the seat of a boy's breeches.

## Electricity

**Electric Hatching of Chicks.**—A third of a million chickens a season is the proposed capacity which a customer of the Electric Power Company of Portland, Ore., intends to attain in his electrically-operated chicken farm known as "Henacres." His output this season will be in the neighborhood of 100,000 chickens, as compared with 45,000 for last year. This farm started with one small electric incubator in 1915 and now is equipped to operate on a large scale, having a single incubator with a capacity of 20,000 eggs. The total connected load for this plant consists of 33.5 kilowatts of heating and 3 kilowatts of lighting. For emergency service, continues *Electrical Review*, a 20-kilowatt direct current generator is installed at the farm and is so arranged that it may be driven from the owner's truck.

**Britain's Wireless Chain.**—The long-contemplated plan to connect all parts of the British Empire by wireless telegraph has received fresh impetus through the issue of a report of the committee appointed by the Government to formulate such a scheme. The committee's report, which is unanimous, recommends that the Empire shall be linked up wirelessly by stages of about 2,000 miles each and that the system employed shall be that of the generation of radio-telegraphic energy by vacuum tubes. The scheme contemplates two main chains of wireless, one receiving dispatches from Africa and the other from Asia and Australasia, both with Cairo as their first station. For the first link of the first chain a connection would be made on the Poulsen arc system between Oxford and Cairo, which the Post Office Department has nearly completed.

**Electric Purification of Air.**—In a recent *Comptes Rendus* there appears an interesting account of experiments conducted by D'Arsonval, Bordas and Touplain of France, on the electric purification of air. A simple apparatus was used for this purpose, namely, a brass tube 1 meter long with an axial wire, air being passed through the tube at the rate of 127 cu. m. (4,500 cu. ft.) an hour. The air was purposely polluted with a fine sterile mineral powder and also with dried cultures of a certain microbe. After passing through the tube, the central wire being maintained at a negative potential of 50,000 volts, the air was found to be absolutely sterile, while 95 to 97 per cent of the powder was removed. Before passing the tube samples of air gave 150 cultures of the microbe per cubic meter. It is suggested that the ozonization may have aided in destroying the microbes.

**A Vacuum Tube Transmitter.**—In order to utilize a radio-frequency wave train of given power most effectively in a non-oscillating receiving system it must be completely modulated at some suitable audio frequency. A convenient way of accomplishing this modulation, when an electron tube generator is used, is by supplying the plate circuit of the tube or tubes with an audio-frequency alternating current. An alternator may be used with suitable transformers to supply both the filament and plate circuits. A self-contained transmitting set of this type has been designed and built at the Bureau of Standards, Washington, D. C. A description of the set, with photograph and diagrams, is given in the Bureau's Scientific Paper No. 381, entitled "An Electron Tube Transmitter of Completely Modulated Waves." Overall efficiency as high as 35 per cent is obtained with the set.

**Durability of Electric Heaters for Distillation** of gasoline is covered in one of the recent reports of the Bureau of Mines. An electric gasoline distillation heater and a commercial device sold for the same use have been subjected to life tests at a maximum current load. Each failed at the end of approximately 500 hours, the bureau heater through deterioration of the resistance wire and the commercial heater through disintegration of the block of insulating material holding the resistance wire. The bureau heater has an inverted conical resistance element surrounded by a layer of heat-insulating material and mounted in a metal case having a top of hard asbestos board. The resistance element is a helix of nickel-chromium alloy wire held by a molded core of alundum. The commercial heater has a helix of nickel-chromium alloy wire resting in a spiral groove cut in a depression in a block of heat-insulating composition. The coils of wire are held in place by a special cross of sheet mica.

## Science

**The Centenary of Sir Joseph Banks,** who died June 17, 1820, was commemorated June 17 of this year by the Linnean Society, in London, with a program of papers relating to Banks and his work and an exhibition of objects connected with his life. One of the papers presented was, the author stated, based on the daily use of specimens from Bank's herbarium, now in the British Museum. Sir Joseph Banks, Bart., was president of the Royal Society for 42 years.

**A New Journal of Genetics,** known as *Hereditas,* has just been started by the Mendelian Society of Lund, Sweden, the president of which is Prof. H. Nilsson-Ehle, well known for his breeding experiments with wheat. The journal will be published about three times annually, and will contain papers in English, French and German. It will deal with problems of man as well as of plants and animals. The subscription price is 25 Swedish crowns per volume.

**Protection of Alaskan Animals.**—In accordance with a recent Act of Congress, the duty of protecting land fur-bearing animals in Alaska, formerly entrusted to the Department of Commerce, was transferred July 1 to the Department of Agriculture and has been assigned to the Biological Survey of the latter department. The Secretary of Agriculture has issued regulations conforming generally to those previously in force with regard to the hunting of the animals in question, shipment of furs, etc.

**A Student of Ball Lightning.** The Reverend Ignazio Galli, ex-director of the observatory of Velletri, who died February 1 of this year, at the age of 79, was one of the most interesting personalities in the scientific world of Italy. We had occasion, a few years ago, to refer editorially to Galli's keen interest in the project of reviving Latin as the international language of science. He has been a versatile writer on scientific topics, but has been especially prominent in recent years as a collector of information concerning the still enigmatical phenomenon of ball lightning on which he has published a long series of papers.

**International Geodetic and Geophysical Union.**—National unions affiliated with this international body have been organized in Great Britain, Japan, France, Canada and the United States. Each national union has its subdivisions, representing individual sciences. The American Geophysical Union, permanently organized this year under the auspices of the National Research Council, elected officers April 23. Mr. Wm. Bowie of the Coast and Geodetic Survey is chairman, Dr. L. A. Bauer of the Carnegie Department of Terrestrial Magnetism, vice-chairman, and Dr. Harry O. Wood, secretary. A new section devoted to geophysical chemistry has been added to this body.

**The Meyer Memorial Medal.**—When the well-known agricultural explorer, Frank N. Meyer, lost his life in the Yangtze River, in 1918, he left a bequest of a thousand dollars to the staff of the U. S. Office of Foreign Seed and Plant Introduction. The recipients of this bequest have put the money into a permanent tribute to Meyer's memory in the shape of a medal to be awarded for distinguished service in plant introduction. The awards are to be made by the council of the American Genetic Association. The medal was awarded for the first time on May 3, 1920, the medalist being Mr. Barbour Lathrop, one of the founders of the plant and seed introduction work of the United States Government.

**Long-range Weather Prophets.**—The erudite and versatile director of the Prussian Meteorological institute, Dr. Gustav Hellman, has recently issued a second series of contributions to the history of meteorology, one paper of which deals at length with the non-scientific long-range weather forecasters of the 19th and present centuries. The popular celebrity acquired by many of these persons is a remarkable example of human gullibility. Although we miss the names of some recent American weather seers of wide reputation, Dr. Hellman's list is impressively long. He gives detailed accounts of the activities and publications of 105 long-range forecasters, distributed as to nationality as follows: Belgium, 2; Germany, 36; England, 25; France, 14; Italy, 2; Austria-Hungary, 8; Russia, 1; Sweden, 1; Switzerland, 5; Spain, 2; North America, 9.

## Aeronautics

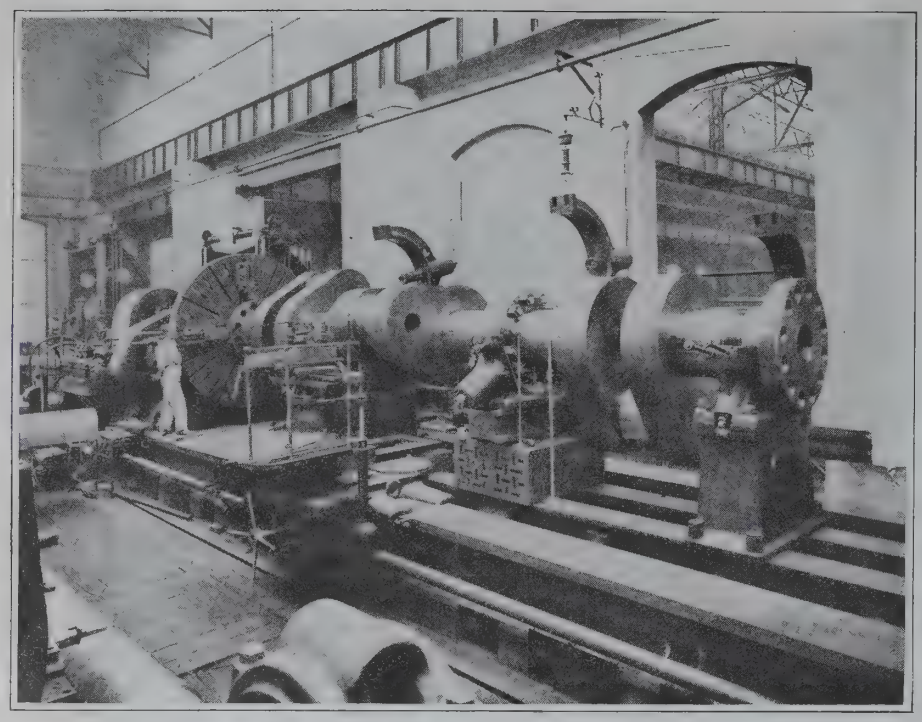
**Army Airplanes Have Reached Alaska** after a flight from Mitchel Field, Long Island. Four machines started on this long journey and every one finished. They came to ground on the flats of the Stikine River, some seven miles from Ketchikan, Alaska.

**Clear View in Bad Weather** is the object of a special screen devised by an Englishman, George Kent, and now being used extensively on the most up-to-date British planes. The clear vision screen is simply a disk of glass driven at a high rate of speed either by a small propeller carried on one of the struts, or by vanes fixed around the periphery of the disk. The disk, half of which is exposed, comprises the entire windshield. It maintains clear look-out in spite of rain or snow, or even oil thrown from the engine or tractor.

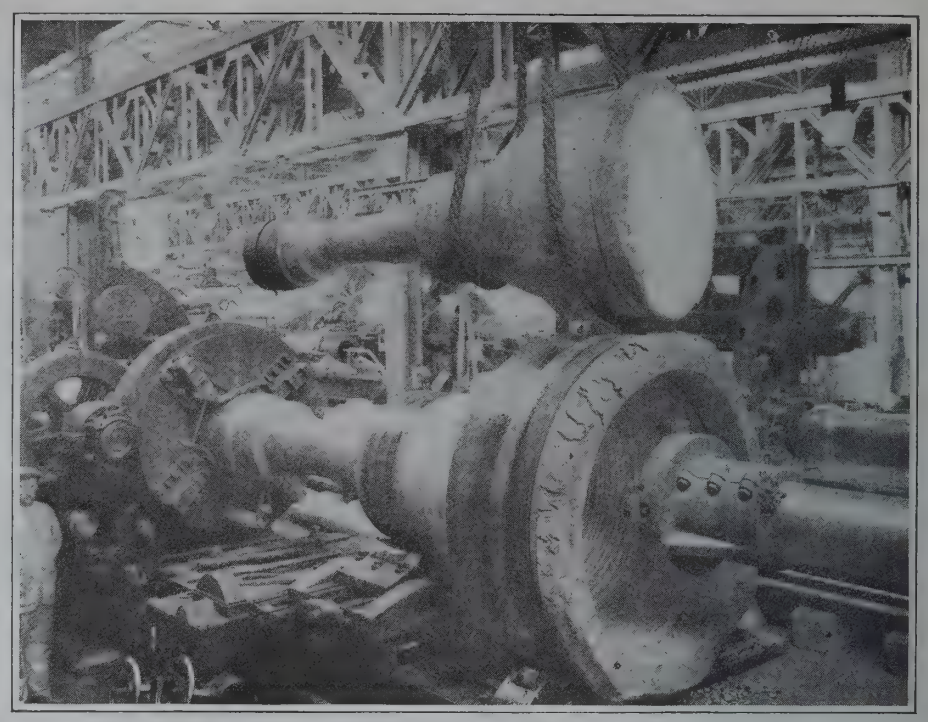
**An Auxiliary Starting Battery.**—In order to conserve the storage batteries which are a part of the equipment of the Curtiss Seagull three-seater flying boat, the Curtiss Flying Station at Atlantic City, N. J., has devised an ingenious device which has materially cut down costs and energy. The station fleet of flying boats is kept busy in passenger carrying. Between each flight ranging from 15 to 25 minutes, the motor is stopped necessitating considerable wear of the battery which is used on the self-starter. To eliminate the cost and bother of recharging the batteries, this flying station has introduced a small handcar or "baby carriage" which carries the largest sized regular storage battery made. To start the motor of a flying boat, the "baby carriage" is wheeled up alongside and proper connections made. Thus the small storage battery aboard the seaplane is reserved for emergency purposes.

**The "Joy-Stick" Patent Claims.**—The war served to make us forget, at least temporarily, the matter of aeronautical patents. But with the excitement and rush of wartime aeronautical construction at last subsided, the various patent suits which have been hanging fire all these years are again coming into action. Thus French and British aircraft constructors are no doubt losing considerable sleep over the claims of M. Robert Esnault-Pelterie, who in 1907 patented the single lever for operating both longitudinal and lateral controls. Some time before the outbreak of the war in 1914 he instituted proceedings against various firms of airplane constructors, which, however, were interrupted by the outbreak of hostilities. In 1918 this inventor and aviation pioneer reopened his action against alleged infringers of the patent in question, claiming a sum of 2,000 francs in respect to each machine fitted with the device. It is estimated that the total sum involved is something over 50 millions of francs.

**Should We Import Foreign Planes?**—There is considerable feeling amongst American aircraft manufacturers concerning the importation of British and French machines into this country. The disposal boards of these countries have resold at a low cost to various firms the machines due under contract. Hundreds of these aircraft were never used owing to the armistice. Now these machines are being sent over here and are put on the market at a figure with which the American manufacturer is at present unable to compete. On the face of it, competition of this class is scarcely fair. It is true, of course, that the majority of the Americans who flew in France used British and French machines for the good reason that there were almost none of American make there before the armistice. There is no doubt that the boys got to know and to like the foreign makes, and there will be a natural tendency for them to buy the types whose record they know and which they know how to handle, particularly at a lower price than the entirely American machine can be turned out. The American aircraft industry has still a lot to learn from foreign technique, however, and the introduction of these aircraft should stimulate them to increased production. To prevent foreign entries by legislation is merely to hamper the advance of aviation and to put this country far behind Europe in the development of the science. If there were no demand for foreign machines there would be no supply.



Machining a huge crankshaft for marine use in the factory that used to make Austria's guns



Forming the end of a large shaft in the part of the works once given over to munitions making

# Turning the Skoda Works from Swords to Plowshares

## How the Austrian Krupp's, Under Czecho-Slovak Auspices, Is Producing Munitions of Peace

By Arthur J. Herschmann and Carl Scheid

AMERICANS are apt to form a wrong idea of what the new republic of Czecho-Slovakia comprises and what it is. The population is about 12 million and the territory about 130,000 square kilometers. Composed for the most part of the old kingdom of Bohemia with its wealth in gold, silver, iron, lignite, coal, graphite and radium, its chief adjunct is Moravia, which country is a very large agricultural and industrial factor. The railroads of the new republic measure about 6,000 miles and there are some 200,000 men employed in the iron industry of the country. During 1917 the production of the iron industry was 17 million hundredweight and there were imported from Sweden 10 million hundredweight of iron ore, quartz, coke and coal from Germany, besides limestone from Poland, and ferromanganese from Jugo-Slavia.

Great and significant changes are going on in the industries of Continental Europe and while we Americans are looking on, the other big nations are taking an active part and are becoming connected with the leading enterprises of the new republics. English and Italian interests have bought into Austrian steelworks and engineering plants, and chief among the French investments we will here concern ourselves with the famous Skoda Works which are now controlled by Schneider of Crusot.

Emil von Skoda took these works over in 1869 when they employed but 150 men on engineering work of a general nature. Today these works have a capital of $29,000,000 and an area of 1,325 acres of which 100 acres are built upon. There are over 7,000 machines and the horse-power generated within the works is 43,500. There have been as many as 3,000 clerks and office employes and over 33,000 men at work in the shops. The Skoda Works own their coal and iron mines and are equipped in the most thoroughly modern way. Together with their subsidiary plants they are self-sufficient and can produce almost anything that is made out of metal.

The headquarters are at Prague; the technical offices as well as the administrative departments are at Pilsen, Bohemia, where the works are located, west of Prague. Here are 9 Siemens-Martin furnaces equipped with most modern charging devices and operated in part as basic and in part as acid furnaces; they have a combined capacity of 300 tons and steel castings up to 100 tons in weight can be turned out of any quality and finished or in the rough. This department has supplied rudderposts, propellers, foundation plates, crankshafts and the like for the best known passenger vessels and warships of many European and Asiatic nations. Skoda Works make the softest dynamo steel of highest magnetic quality as well as the hardest steel for stone crushers, cement mills, and the steel department also produces flywheels over 60 tons in weight, wheels for water turbines, frames for rolling mills, anvils, railroad material of cast steel, etc. There is a special ingot foundry to serve the forges and rolling mills. Here large blocks are put under high pressure after the "Harmet" process and alloys are produced, free from blowholes, up to 105 tons in weight.

The foundry has 22 electric traveling cranes and 7 hydraulic jib cranes from 10 to 80 tons capacity, 7 large drying ovens besides large numbers of molding machines and a plant for the preparing of the sand.

Then spacious tempering ovens serve to treat the castings after they have been cleaned with compressed air tools, sandblast and cleaning machines of various kind. There are 2 magnetic traveling cranes with a span of 135 feet and a lifting capacity of 6 tons. The foundry has its own machine shop of over 12,000 square yards floor space, 11 electric cranes and among the tools is one which will turn pieces measuring 35 feet in diameter with great accuracy.

Here are steel furnaces of 4- and 6-ton capacity for thin quality castings of electric steel and 5 converter steel furnaces of 2 tons each. The iron foundry has several cupolas with Dutch ovens of an hourly capacity of 45,000 pounds, and there is a gas-fired furnace for the melting of quality iron which has a capacity of 10 tons. This department also contains 8 electric travelers from 3 to 60 tons capacity.

The metal foundry has 17 furnaces and produces castings up to 11,000 pounds in weight. Every kind of bronze is made, forged or cast, and the manufacture of aluminum castings of special alloy for automotive purposes and internal combustion engines is made a feature of production. The pattern-making shop covers 7,000 square yards and contains up-to-date American wood-working machinery.

The blacksmithing branch of manufacture is maintained in 7 halls of 22,000 square yards and has 9 steam-hydraulic presses, the largest of 5,000 tons pressure, several large steam hammers, hydraulic crowning presses, several rolling mills for tire material for car wheels, locomotive and tender tires. This section commands over 60 electrically-driven machines of modern construction, including lathes of 12 feet swing and 90 feet between the points, vertical boring mills of 18 feet diameter of the work, and shapers of 6 feet stroke. Tools to finish crankshafts are here of an accuracy of 2/100 of one millimeter. Boring mills of this department can handle tubes of almost 100 feet of length.

Thirty heating furnaces serve to treat the ingots with thermo-electric devices. For transportation and for the forges 35 electric traveling cranes are installed of a capacity of from 10 to 60 tons. Forgings are made up to 180,000 pounds for marine purposes, shafts up to 90 feet in length (see illustration), piston rods, connecting rods, rotors for turbines, and rolling stock of every conceivable kind. In the small forge are 17 steam hammers from 50 to 1,500 tons in capacity and 63 fires, 15 cranes from 3 to 5 tons capacity besides 2 main gantry cranes. Pieces are forged up to 5,500 pounds in weight.

A building of 10,000 square yards houses the spindle press plant and contains

A novel kind of marine propeller made at the Skoda establishment

24 eccentric presses, 42 spindle presses with spindles up to one foot in diameter, 4 air hammers up to 300 pounds in weight, 4 shears up to 2 inches capacity. There is also the gear works with special machinery to produce wheels up to 15 feet in diameter of every material.

The locomotive works, which was founded in 1918, has 4 large buildings devoted to manufacture and repair of locomotives and to boilermaking. Over 200 modern tools produce the mechanical parts in the repair plant, and this young department already employs over 1,100 men and turns out and reconstructs 300 locomotives each year. The area covered is 33,000 square yards.

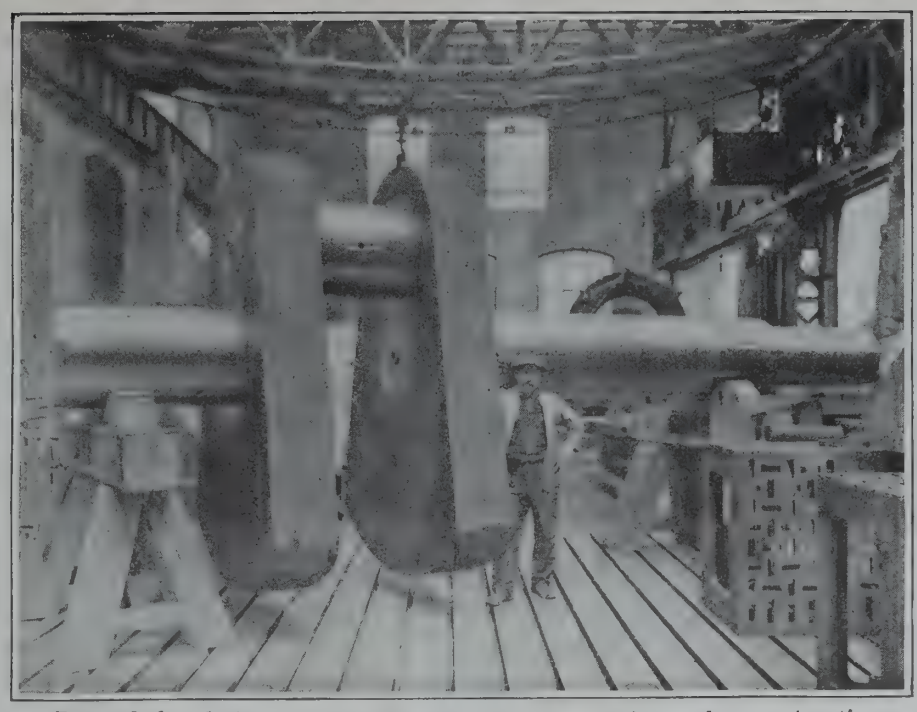
The automobile factory, which is a new department, makes tractors, ploughs and explosion engines. The area covered is 45,000 square yards and there will be employed 1,400 men. Up-to-date machinery is being added which will give a capacity of 900 motor ploughs and tractors, besides 1,000 agricultural locomobiles.

This great munitions plant, which has been famous for many years, is now being diverted to the making of printing presses, agricultural machines and the like. A separate testing laboratory is installed to insure perfect product and the Skoda Works have their own proving grounds where armor plates as well as projectiles and guns are tested. There is a complete munition works in connection with the gun works and there is a special testing plant for these munition works at Nuerschan and Bolawetz near by.

This large electric generating station furnishes steam and current for the entire works, does the driving and heating of the shops and produces oxygen and hydrogen for the welding and cutting flames. Electric current is supplied by the station 1 at the northern boundary of the works at Pilsen and the station 2 at the Pankraz mine in Nuerschan. Interconnection is made by long distance line of 8 miles in length which carries current of 50,000 volts and of 50 cycles.

An extensive mechanical carrying plant is installed for the handling of coal and ashes from and to the coal mines of the works. The main stacks are 250 feet in height and about 12 feet in diameter at the top. Exhaust steam is used for the heating during the winter season and the condensate from the turbines is fed back into the boilers. A filtration plant of 500 cubic feet hourly capacity supplies the make-up water of the boilers.

The turbogenerators range in size from 300 to 10,000 and are of 3,000 volts. There are 313 electric cranes ranging from 120 tons capacity down. Eleven of these are of 60 tons capacity. The installed horse-power of these 937 crane motors is 24,000 horse-power and there are besides 1,050 motors in the works of 25,100 combined horse-power. The oxygen plant is contained in separate buildings, also the hydrogen works. Electrolytic as well as "Linde" systems are here in use.



**Part of the shaft of a 10,000 horse-power gas engine under construction at the Skoda plant**

## The Greatest of Floating Cranes

By Ralph Howard

IT isn't every crane that looks the part. But there are very modern fellows that resemble their namesake pretty well. That is, they are capable of bending over to pick up something. The giant crane built for the British Admiralty is a case in point. The monster is very tall when in erect position. It may readily be bent over to reach a fairly distant load. Other notable instances of gigantic cranes of the same type are the two which are in service at the Panama Canal.

All three of these are mounted upon pontoons and are in consequence styled floating cranes. All of them are capable of lifting a maximum load of 250 tons. But the one which operates in British waters nevertheless outranks the others because it is able to secure and handle its maximum load at a greater horizontal distance. On may readily understand that, while the load lifted is a principal factor in a crane's capacity, nevertheless the outboard reach is also of importance.

Perhaps we ought to mention here another installation—a pair of cranes mounted on a single pontoon—each capable of lifting 200 tons so that the total of lifting ability exercised from the one pontoon is 400 tons. But this is hardly to be undertsood as an ability to lift and transfer, after the manner of a rotating crane, a single load of this total weight. The makers of the British crane claim the palm, and it may very properly be allowed them.

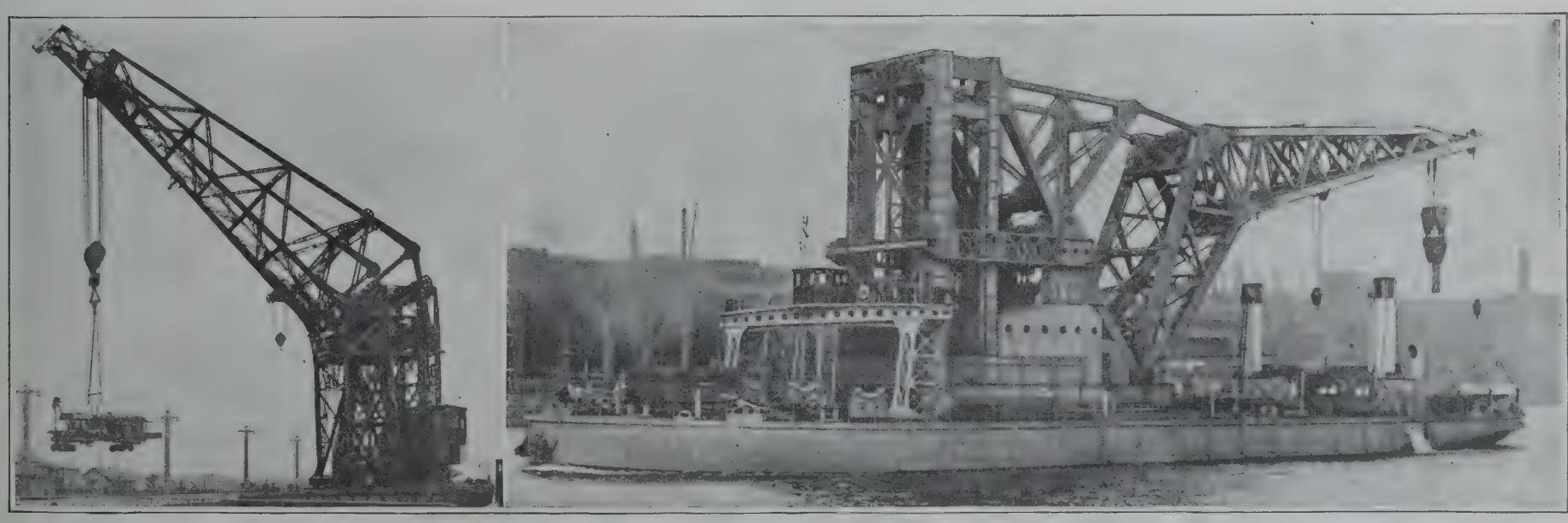
The greatest of floating cranes in the world is known in the British Navy officially by the very commonplace title of *Crane Lighter No. 4*. It lifts 250 tons at a radius of 100 feet. This is its greatest normal maximum effort. But it is capable of other normal maximum efforts. This requires a little explanation.

The arm which reaches out like the neck of a living crane and while at a more or less oblique angle provides support for the hoisting of the load is termed the jib. When the greatest of all efforts is made, the jib has an angle of perhaps 40 or 45 degrees to the horizontal. The lift is not made from the extreme tip of the jib but from a point somewhat back of it. The reach is estimated horizontally from a vertical plane through the center line of the pontoon to the steel ropes which support the load. The gravity pull of 250 tons at a distance of 100 feet from the center of the deck naturally tips the pontoon considerably. The height of the lift possible may be roughly estimated as the difference in level between the hook carrying the load when at its maximum height, and the lowest points of the tipped deck. Measured thus, *Crane Lighter No. 4* can lift the 250 tons at a distance of 100 feet to a level about 77½ feet above the water. Naturally, the block-and-tackle arrangement at the tip of the jib will, under the foregoing conditions, be at a higher level than the inner one. By depressing the angle of the jib, the reach possible with both blocks is increased. When the reach of the inner hoisting rig is at 110, 115, 130 and 137 feet, the possible maximum loads are 200, 150, 100 and 75 tons. At the farthest reach the jib is well-nigh horizontal. The block at the tip of the jib is capable of lifting 30 tons. This load may be lifted by the crane from this block at all reaches of the full jib up to 150 feet. It will be seen from the foregoing statements that this great crane is able to handle a great variety of work.

The pontoon which carries the crane is a pretty big boat, being 242 feet long overall and having a molded breadth of 86½ feet. The center of the base of the crane is somewhat forward of exact amidships. Suitable areas are provided on the pontoon's deck, ahead and astern of the crane for the loads to be handled. Consequently, with the crane exactly alongside of a position on a battleship where a gun mounting is to be deposited, the crane will have the duty of lifting the mounting from the pontoon's deck, swinging itself around through a horizontal right angle and lowering the mounting into place. But there is a further requirement. The reach of the crane when securing the load is much less than the reach of 100 feet which it might be called upon to use in depositing. Necessarily, then, the reach has to be changed while the crane has the load. In fact, it is possible for the unloaded crane to set itself at the start at a reach of only 51 feet from its own vertical axis of rotation.

The base of the crane rests on rollers, these rolling in a path or orbit of 25 feet radius. With the addi-

(*Continued on page 260*)



The view at the left shows one of two identical outfits at Panama; that at the right is of the largest pontoon crane in the world, belonging to the British navy.

**Two huge cranes that float on barges and stoop to lift their loads**

# Succeeding in Safety Engineering

## The Man Who Makes Industry Safe for the Worker, and What He May Hope to Get Out of It

By Raymond Francis Yates

THE author feels that this is one of the most important subjects he has treated in this series. Safety Engineering has to do with saving human lives. What could be more worthy? It is described as "the development and application of engineering ways and means of accident prevention." It is an engineering science that has grow out of our complicated, and in many cases treacherously hazardous, industrial development. It is indeed the science of saving life and limb—it is the application of engineering principles to lessen human misery. It is a great humane movement, which, in spite of its youth, has already saved many a breadwinner for his family.

Mr. H. W. Mowery, President of the American Society of Safety Engineers was kind enough to give the author the data embodied in this article. Mr. Mowery has a big, broad humanitarian version of safety engineering and the writer can feel the tang of his inspiration as he writes these lines. As President of the American Society of Safety Engineers, Mr. Mowery is one of the leading spirits of this work in America. Every day he is putting his heart and soul into the work of spreading the gospel of safety.

We will start this article by considering the service a safety engineer renders his country. First and foremost he is a protector of human life. He also prevents men from being maimed and crippled. From an economic point of view he protects that portion of the total casualties yearly, causing a waste of approximately $720,000,000, which is preventable by engineering revision.

What education should a safety engineer have? This is somewhat difficult to answer. It is not only education that is necessary for a successful safety engineer. The personal factor enters into this matter. There are certain personal qualities that contribute to the success of a man working in this field. He must be sort of a "human" engineer also, that is he must know how to engineer human beings. He should be amiable, kind-hearted, patient and quick to see things that endanger life and limb. He must possess a pleasing personality. It is no profession for a "grouch."

The purely technical side of a safety engineer's education must be somewhat general. He should be thoroughly grounded in all the fundamentals of engineering. He must have a good technical education gained in college or outside of college, it makes no difference. The man training himself for this work should be fully conscious of his responsibility. He must realize that he is to be a guardian over human life and that his mistakes are very apt to be sad ones. It would seem that any man educating himself with these facts in mind should try to make a good job of it.

A young man may say to himself, How do I know that I have the proper personality to succeed in safety engineering? He can answer himself by asking himself these questions: How many friends have I? Do I get along well with my fellow workers? Do I get along well with my superiors? Am I a good sport? Do I swear and lose my temper when my collar button drops down the back of my neck or under the dresser? The last question is a good test for patience.

The young man reading this article should constantly keep in mind the fact that safety engineering is one of the infants of the engineering profession. It has not yet reached its economic level and the question of salary cannot as yet be clearly defined. Some men receive $2,000 per year while others are receiving as much as $15,000. It is regrettable that the majority of industries are not as yet thoroughly awakened to the value of accident prevention work. Consequently they do not offer salaries that attract men of the type needed in this work. In a general way it can be said that the salary of an expert in safety engineering would be determined by his value to the organization employing him. In other words it will be determined at present by the amount of saving he makes in compensation, hospital, medical and other direct and indirect losses. Of course the lower these expenditures are the lower will be the number of accident occurring in the factory.

Mr. Mowery informed the author that as yet many safety engineers have not gone into business for themselves. In the same breath he also mentioned that this was probably because of the fact that there are not many real safety engineers. The profession is developing rapidly but at present most of its followers are employed by State labor departments, insurance companies and large industrial organizations. There is a great opportunity for safety engineers to go into business for themselves and provide service for a clientele made up of the smaller plants.

Unfortunately our colleges have not yet recognized safety engineering in their courses. An effort is being made to have the fundamentals of safety engineering incorporated in existing technical courses and a special course created that will officially authenticate those who qualify as safety engineers. The American Society of Safety Engineers is now considering the formulation of a curriculum for the education of safety engineers.

The present demand for men trained in safety engineering is far in excess of the supply. Mr. Mowery believes that it will be for many years to come. It will surprise many to know that thirty-nine States of the Union have some form of Workmens' Compensation Law. The demand has grown rapidly as a result of the urge from State labor departments, insurance companies, etc., to safeguard employes. At present, most of the recommendations are made by inspectors from insurance companies and State departments. The employer will eventually call in a safety engineer to cure unsafe conditions in his plant just as he would call in a physician to cure any unwholesome conditions of his body. There are several companies which make a specialty of providing such services to industrial establishments.

It seems that there is no great demand for specialists in safety engineering. It may be that a man may become better qualified, through experience, to handle electrical hazards than other kinds. Another man may specialize on hazards in chemical industries, another in railroad work, etc. In general it can be said that a safety engineer should be capable of intelligently handling any kind of hazards. The author asked Mr. Mowery how long a man should train himself to become a thoroughly capable safety engineer. He said that everything depended upon the man, and added: "One cannot expect to master the fundamentals of engineering, and of safety engineering in particular, by listening to a course of a dozen lectures, and while I am certainly disposed to approve the custom of holding night schools for foremen, giving them condensed interesting talks on safety of a nature to bring about their coöperation, however, I surely do not approve of giving them diplomas indicating that they have graduated from a course in safety. It creates a wrong impression in the minds of the men, and serves to lower the standard of safety engineering through possible misunderstanding. Recently a foreman, having graduated from such a course, advertised for a position as safety engineer, describing himself a 'good mixer.'

"The idea that I have had in mind for years, and which I think it would be well for every safety engineer to have, is, 'to make material conditions so safe that a person may pursue in safety his normal activities without abnormal care.' I believe that educational activities and general propaganda are vital to the spread of the gospel of accident prevention, but I believe that actually to prevent the accidents the material conditions must be made safe. People—whether educated in safety practices or not—at least will not be injured by a hazard removed.

"That there will hereafter be some form of safety engineering is sure. But whether the activities directed to prevention of accidents will be continued by lawyers, doctors, favored nephews, foremen, etc., or by members of the various safety engineering professions becoming inoculated with the safety idea so thoroughly that they will incorporate it in all of their work, thinking of safety in preference to the activities whereby they have gained their distinguishing name; or whether it will be necessary to establish another branch of engineering to be known as 'Safety Engineering' remains to be seen. I am inclined to be of the opinion that safety engineering as a profession, to cure conditions that are causing the present great waste in life and property, is surely developing. I believe the safety engineer's work is becoming clearly defined and he need make no apology or abject pleading for his profession. In a single plant, he has reduced the casualty cost of $35,000 per year, in 5 years' effort to $4.500 per year. But it is unreasonable to expect mechanical, electrical, or any other type of engineers to do other than stress those phases of engineering through the practice of which they have obtained and retain their distinguishing name. They will not stress safety engineering any more than will a physician or a dentist. A certain type of engineer strives to create something in his particular line. He views his work from that angle. If it is a means of production, a safety engineer will be called in for he will look at it from an entirely different angle, namely, safety to life and limb rather than quantity or speed of production. He sees that it is safe; that is his duty, his profession."

There is great opportunity for a display of genius in the safety engineering field. Already the patent office has granted a large number of patents dealing with safety devices. We are at the dawn of the safety age. Safety engineering is not only the application of engineering principles to life protection, but also the science of developing and perfecting additional devices that make dangerous industrial operations safe. The well-known punch press is an instance of safety engineering applied to dangerous machines. A few years ago the punch press was responsible for the loss of a great number of hands and fingers yearly. Along came the safety engineer and today these presses are "muzzled" and with reasonable care on the part of the operator there is not much excuse for accidents. If the hand is under the die when the press is tripped the ram will come down a certain distance and stop.

The safety engineer has encased belts, covered gear wheels, made men wear goggles, put spikes in the ends of ladders, illuminated dark places, made men cut sleeves off short when working around machinery, put railings where they were needed, improved insulations, ventilated our factories—and these with many other things he has done in such a way that their doing has actually been financially profitable to the employer.

Nothing must escape the keen eye of the safety engineer. There are two things he must keep constanly in mind. First and foremost is the saving of life and limb. Then, too, he must remember that this is to be done with a minimum sacrifice of efficiency. In most instances there is absolutely no sacrifice of efficiency, and, in some cases, there is an actual gain in efficiency through the introduction of safety methods. When a workman feels that he is protected it instills confidence in him and he may work faster without keeping his mind on protecting himself.

*EVERYBODY who works with his hands knows that today there is a great deal more attention paid to means for helping him avoid accidents than there was some years ago; and everybody who reads knows that there is a lot more talk about this sort of thing than ever before. But perhaps everybody does not know that the effort to make industry safe for the workers has given rise to a new profession. In the beginning, doubtless, it was left to the mechanical engineer to make machinery safe, and to the electrical engineer to make electrical apparatus safe, and similarly in other fields. Today, however, it is found that with one man to attend to all this, to co-ordinate the work in the various fields, and to bring the legislative and medical angles of the proposition into harmony with the practical, the results are so vastly improved that the safety engineer amply justifies his existence. In this article Mr. Yates considers the further point of whether the opportunities in this field justify a young man in making it his profession.*

—THE EDITOR.

# Names That Live in Our Language

## Some of the Men Whose Exploits Are Commemorated by Nouns and Adjectives

By D. Waterson

THE desire to be remembered or to have our dead remembered has existed since the world began. Thousands of human-built memorials have long ago crumbled to dust, but mountain and river, tree and flower, state and town and mineral perennially perpetuate a name, though the bearer and that which he did are but dimly recalled except by the erudite. *Pike's* Peak, the river *Livingstone*, *Douglas* pine, *Dahlia* blossom, *Pennsylvania*, *Carnotite*, etc., are memorials of worthy men.

Some names have passed into everyday speech, some are adjectives, every great discovery or international crisis erects another mental monument, especially war, though, after a time, many perish altogether and the others require a biographical dictionary for elucidation.

It would be particularly puzzling to decide which of the proper names that have entered into the current slang and semi-slang of the day will and which will not survive. Merkle and Dr. Cook as symbols of utter stupidity and fraudulent claims have been crowded out by the latest sporting idiom, which refers to knock-outs and home runs as Jack Dempseys and Babe Ruths; will these terms, too, pass along with the bearers of the names which they commemorate, or will they become a lasting part of the language? The answer to this query is perhaps less doubtful in the case of scientists and inventors than in that of sporting idols and nine-day occupants of the front page of sensationalism; but there must always be some doubt. Nevertheless, a great multitude of such terms survive in the body of unquestioned English.

Particularly striking is the large group of memorial names in the electric and radioactive world; I have grouped a few together to interest those who constantly use the terms yet do not know their derivation:

The measurement for pressure or electromotive force is a *volt* named after Alessandro Volta (1745-1827), an Italian physicist, originator of the electrophore, electroscope and the Voltaic pile and who proved Galvani (*galvanize*) wrong in his theory of animal magnetism. The student reads that the *ampère* unit of electricity gives the rate of flow, i. e. it takes one *volt* of pressure to drive a current of one *ampère* strength through a resistance of one *ohm*, but he does not gain the additional interest of knowing that André Marie Ampère (1775-1836) was a French electrician and "the father of electro-dynamics," who found that two parallel conducting wires attract each other when the current traverses them in the same direction but repel each other when the current flows in opposite directions. George Simon Ohm (1789-1854), a German physicist, claims the *ohm* law that the electromotive force divided by the resistance is equal to the strength of the current.

The *watt* is one *volt* multiplied by one *ampère*, but James Watt (1736-1819), inventor of the condensing steam engine and his work is generally known. The unit was too small to be convenient, so electricians adopted 1,000 watts as a commercial unit of power and named this a *kilowatt*.

The *coulomb* brings into view Charles Auguste de Coulomb, a French scientist (1736-1806), who invented the torsion balance, which gave two new inverse square laws in addition to the Newtonian one of gravitation. A *coulomb* is the quantity of electricity required to produce a definite chemical effect—to deposit 1.1183 milligrams of silver.

And a *mache?* It was a German physicist, Heinrich Mache, still living, and his co-worker, St. Mayer, who hold this unitary honor, the unit representing the quantity of radium emanation, without disintegration products, which produces a current of limited saturation.

The *joule* is named after James Prescott Joule (1818-1889) of Manchester, England, the unit being the energy expended in one second by a current of one *ampère* passing through a resistance of one *ohm*.

It is hardly necessary to mention the origin of the *Curie* unit which represents the quantity or mass of radium emanation in equilibrium with one milligram and one-thousandth of a milligram respectively, for Marie Curie is still working, though Pierre Curie is dead. She was greatly pleased when the Radiology Congress in Brussels, 1910, determined on the name in memory of the splendid work achieved by the Curies.

I have chosen but one little group, but enumeration of all would take a long article. The *farad* unit (Michael Faraday, 1791-1867) from which faradization comes, could be added, and most readers know of *mesmeric* powers and of being *mesmerized* (Franz Mesmer, 1773-1815).

*Galvanic*, *galvanized* are equally familiar. Luigi Galvani (1737-1796) was a professor of anatomy at Bologna and was noted for his investigations in the contractions produced in the muscles of frogs by contact with metals. This was the beginning of galvanic or voltaic electricity.

There are dozens of names which are used as adjectives: *Hertzian* waves, *röntgen* rays, *coolidge* tube, and, to step a little outside the scientific world, who does not enjoy having a *mackintosh* in winter and the smooth *macadamized* roads? Charles Mackintosh, the Englishman who, in 1823, found he could apply naphtha to cloth and so render it rain-proof, was also doubtless pleased, and John Macadam (1756-1836) certainly found the English roads in a horrible condition when he brought his engineering skill to work on them, France quickly adopting his theories. Another "Mac," this time Macassar, invented a wonderful hair oil early in the 19th century, which was so freely used and the oiled heads so bad for stuffed furniture that "anti-Macassars" came into general use. When Sir Robert Peel instituted the London police force, they were and are known as "Peelers" or "Bobbies."

Some men's characters are perpetuated as uncomplimentary adjectives. All know the *Judas* kiss, a *Macchiavellian* policy (Nicolo Macchiavelli, 1469-1527); and Louis Daguerre (1789-1851), who belonged to the French Internal Revenue Service and who afterwards, with Niépce, invented photographing on metal, had such a reputation for indecision and unreliability that anyone possessing the same faults was spoken of as a mere daguerreotype, or shadow of a man.

It is seen then, that some names will be used forever as terms of honor or dishonor even though the owner as an individual is forgotten. Even today how much does the average person, reading advertisements, know of what splendid achievements and benefits *listerized* gum and *pasteurized* milk remind the man who has read of Lord Lister and Louis Pasteur?

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### Ventilation of the Hudson River Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

That the construction and completion of the tunnels under the Hudson River at Canal Street, intended for vehicle traffic will be a great convenience is proven by the daily congestion at the ferry entrances on both sides of the river. Along with their urgency there is the great importance of proper and ample ventilation without which the tunnels would be useless. The greater number of vehicles, probably 90 per cent of them, will be automobiles and motor trucks, exhaling poisonous gases. On this point the *Literary Digest* for August contains a very instructive article. It concludes with the warning that the contents of carbon monoxide (the most poisonous gas contained in the exhalations of motor vehicles) must not exceed the maximum of four parts in ten thousand parts of air. This conclusion has the endorsement of the United States Bureau of Mines, but the solution of the problem is left entirely to the engineering department of the Commission.

Although a novel problem, the principle of it is simple and easily understood. Fresh air is conducted through a duct the entire length of the tunnel from which holes short distances apart admit the air to stream into the tunnel and dilute the poisonous gases. Another duct, also running the entire length of the tunnel and also connecting with the tunnel through numerous holes, sucks up the contaminated air which is expelled through shafts at each end by mechanical blowers. The ventilation is therefore crosswise of the tunnel and a continuous operation which requires careful designing for its success.

Let us believe that the engineers of the Commission have thoroughly studied the problem, yet it is of such overwhelming importance that the details of that study should be published as proof thereof.

To mention only one point. The velocity of air and gases through the ducts will be very great. The friction along the walls of the duct and through the orifices will consume a great deal of power, which will increase rapidly as the walls of the ducts will become incrustated from the dirt and oily particles in the air. The surface of the ducts will therefore require periodic inspection and cleaning similarly as chimneys require cleaning from soot. To that end the height of the ducts should be sufficient for a man to walk through from end to end, 8,000 feet long. But the height in the plans is only 4 feet 8 inches for lower duct and about 5 feet in upper duct. These heights are too low and would require continuous stooping of the workmen, which is both exhausting and tormenting in long, hot ducts.

Ordinary foresight also requires that in the lower duct provision be made for carrying off the dirt on some narrow gage railway. The upper grating seems hardly strong enough to bear the weight of men.

The clear height of tunnel is only 13½ feet, while the minimum of clearance on our streets under the elevated structure is 14 feet. From all this it appears that the diameter of 29 feet should be increased at least to 32 feet.

No short-sighted economy should expose the users of the tunnel to poisoning by insufficient ventilation. On this point the details cannot be too specific and should be published. The Commission would assume a great responsibility in ignoring this justifiable demand.

MECHANICAL ENGINEER.

### Some Questionable Botany

To the Editor of the SCIENTIFIC AMERICAN:

May I call your attention to some rather unfortunate terms employed and statements made in the article on page 651 of your issue of June 12th?

In the first paragraph we have reference to the "progress in artificial fertilization of seeds." Without comment on the rather unimportant fact that seeds are not fertilized, because of the ovules which are present in the ovary of the flower cannot develop into seeds until they have been fertilized, I want to call attention to the fact that it is not artificial fertilization but artificial pollination which the plant breeder practices. That paragraph and the next contain several loose statements which I pass over lest I seem pedantic; but it is impossible to ignore the sentence reading "As our photographs show, this operation (artificial pollination) consists in elevating the anthers of the flower to be fertilized, then in depositing upon these the pollen of the fertilizing variety." The pollen, of course, is deposited upon the stigma of the pistil, not upon the anther of the stamen.

While I am at it I wish to comment on the letter published on page 645 of the June 12th issue and signed by Homer J. Carleton of Los Angeles. The letter refers to "earth preserved eggs" which Mr. Carleton reports having been offered for sale at Pasig, P. I.

I feel sure that Mr. Carleton must be mistaken in his belief that these eggs were in any way similar to "the ripened eggs of the Chinese." The eggs of which the Tagalog of the provinces near Manila are so fond and which are called facetiously by the Americans "chicken on the half-shell" are, as a matter of fact, not eggs but chickens, for they are nothing more than eggs which have been incubated almost to the point of hatching and then boiled. They are called "balut" or "baloot" by the Tagalog, and are peddled at every station along the railroad running from Manila into La Laguna and Batangas provinces.

During three years' residence in Manila and on the shores of Laguna de Bay I have met many Europeans who professed great disgust at the natives who ate "baloot"; but, though I have never been able to carry my philosophy into action I cannot even yet understand why, when eggs are good to eat before hatching and chickens good to eat after hatching, eggs should not be good food while they are being hatched into chickens!

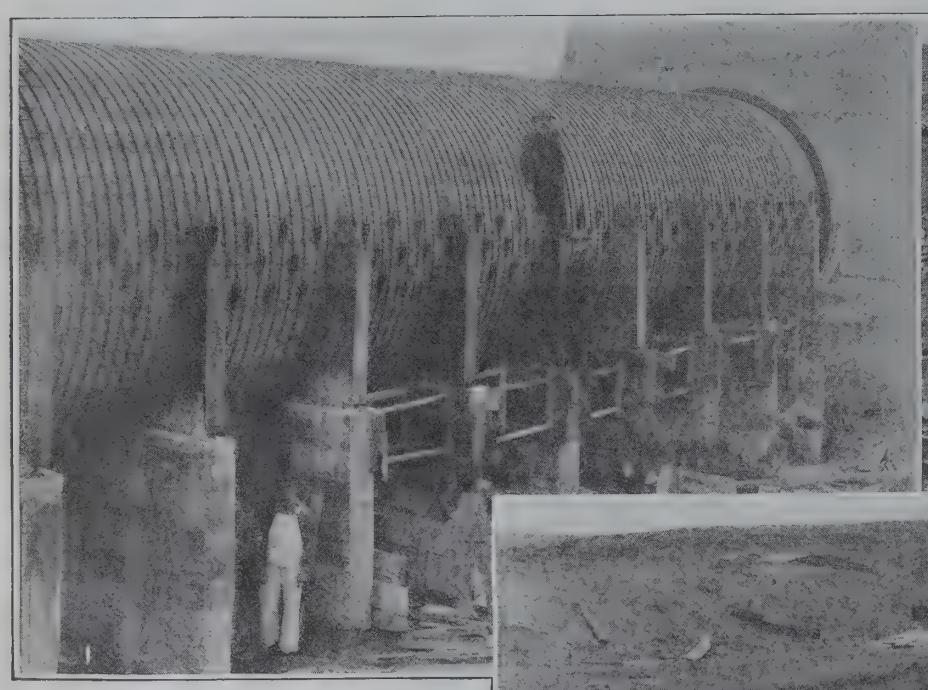
[PROF.] RICHARD M. HOLMAN.

Crawfordsville, Ind.

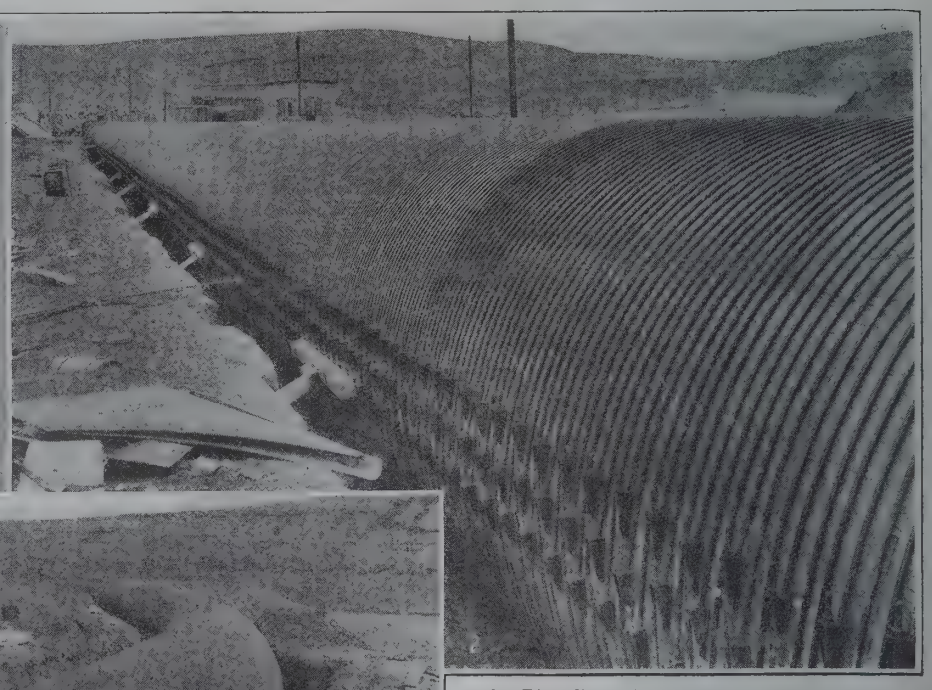
# Water Pipes of Wood

## The Surprising Permanence and Tightness of This Unusual Construction

By J. F. Springer



1. Exposed pipe laid on foundation of concrete wings.



2. Pipe line which will lie partly covered and partly exposed.

3. One of California's biggest pipe lines is of wood.

**Water pipes of wooden staves with hoops of steel**

MANY persons who have not kept in touch with engineering developments of the past few years will perhaps be surprised to learn that wood stave pipe has come into use for the transport over long distances of large quantities of water and the like. Wood, to many of us, seems ill-adapted for out-door service, if long life is to be required. And yet, wooden piles have for a great many years been considered as thoroughly dependable. This is especially the case where the entire pile is well submerged below the water line. Such piles have been taken up after long service and found to be in just about as good condition as when put down. With facts of this description in mind, we shall perhaps be better prepared to understand the use of wood stave pipe in important engineering undertakings.

One of the early instances of an important wood stave pipe line is the semi-cylindrical half-pipe or flume laid in Utah in 1893. The diameter here was 48 inches. The water carried varied considerably in quantity. The maximum head was 70 feet. The whole of the flume was above ground and part of the line was exposed to the full heat of the sun on one side. When 31 years old, this pipe was inspected and the wood found to be undecayed. A sugar factory in California built in 1902 had wood stave pipe for discharge purposes. However, this pipe was in service 4 months of the year and idle 8 months. The engineer concerned not so long ago thought the pipe would have a life of 50 years. Palo Alto, California, near San Francisco Bay, has a sewer of wood stave pipe which runs across the salt marshes on the coast. This line is in part fully buried, in part half buried, and in part completely exposed. Flood tides cover it, at least in part, and ebb tides leave it exposed. It was said, a year or two ago, to be in perfect condition. In 1900 there was built for the water supply service of San Diego and Coronado, both in California, a total of 7½ miles of wood stave pipe—about one-third being of 40 inches diameter, and the two-thirds of 36 inches. The water pressures vary between those due to a head of 150 feet and a head of 295 feet. For nearly the whole length, the pipe line is buried in alkaline soil, but some short lengths are carried across deep ravines on trestles. In 1916 this line was examined and found to be in excellent condition. In fact, it is claimed that the wood was harder than it was originally. Just about all the foregoing pipes were constructed of redwood timber.

It will be seen from the foregoing that wood staves have been tried out under severe and varying conditions. However, there is wood pipe and wood pipe. Just any kind of wood will not suffice. One of the principal requirements that the material which enters into the body of the pipe must fulfil is that it shall resist decay, even if it is not perpetually saturated. Where constant saturation is to be depended upon, several kinds of wood will answer. In fact, perpetual saturation tends to prolong the life of wood in general. There are, however, other considerations which wood pipe must generally fulfil, and these tend to cut down the possible kinds of wood. Redwood, fir, cypress and pine are all in actual use for wood pipe. It is claimed that pitchy woods, like fir and pine, will not last under conditions of partial saturation. The pitch is cited along with the sap as having a tendency to produce deterioration, even if there is saturation. On the other hand, the Canadians have constructed a continuous wood stave pipe line, 8 feet in diameter, of British Columbia fir. This is a good big fellow and indicates Canada's faith in Canadian wood. An American engineer specializing in wood pipe says that fir and pine will, under certain conditions, have a long life and give perfect satisfaction. Thus, if the climate is dry, either wood may be expected to do well, if the erection is such that a circulation of air obtains all round the pipe. Heavy pressure of the contained water when combined with imbedment in compact soil promotes long life. Pressure water is good because pressure produces saturation or tends to do so. Redwood and cypress are said, in some quarters, to be about the only commercial woods suited for alternations of wet and dry climatic conditions. Cypress is, however, said to be becoming more and more unobtainable, except at a price. Apparently, there exist only a few cypress pipes.

Redwood is claimed as really the best commercial wood for pipes and as surpassed only by cast iron in respect to length of life. There seems to be a peculiar constituent of this wood of an acid character. It is of importance as it preserves the fiber against destruction by micro-organisms.

In building wood stave pipe lines, the engineer must be content generally to let cost have serious weight. He will generally have to take some middle course. Thus, thick staves give the better pipe, and wide staves mean reduced cost of erection. But, a pipe is not necessarily as much better as the staves are thicker. And a wide stave may not result in enough saving in erection to pay for the waste of timber thus brought about. A nominal size of 2 x 6 inches has been put forth as a good size of stock for economical manufacture of staves, all things being considered. The nominal thickness and the nominal width will be cut down somewhat. The stock size given will be suitable for all pipe sizes from 26 to 52 inches. In general, the thickness of the stave will vary with the diameter of the pipe. But other considerations enter.

A wood pipe must favor penetration of the water. But it must not permit excessive percolation. The wood may be dense and hard. This may hinder perfect saturation. Then, the wood may consist of alternate portions of hard and soft material—winter and summer wood—under which circumstances excessive percolation is to be feared. The water will find its way out through the soft material between the regions of hard material. Redwood is a very soft and cellular wood. If the sap has been got out, it is resistive to percolation and favors saturation. However, different staves in the same pipe will often differ in the combination of their resistances to percolation with their facilitation of saturation.

It is considered important in constructing a wood stave pipe line that the staves be quite dry at the time of erection. The reason for this is that then the bands may be cinched tight, and the whole pipe made tight when dry. When such a pipe undergoes in service the experience of having the water drawn off the line, the shrinkage of staves, and the consequent opening up of seams, has been forestalled. Even though there should be some shrinkage and some opening up, the return of the water will produce enough swelling to result in tightness. If wet staves are used, they are already swollen; so that the withdrawal of water from the line will result in excessive changes, changes too great for the returning water to rectify with certainty.

The lumber which goes into a pipe line should, it is asserted, be thoroughly air dried. This is the natural process. Kiln dried lumber is condemned, if the drying is carried out by the older process. There is a newer procedure which employs steam indirectly, and makes use of a circulation of air having a proper temperature and a proper humidity. Under the old kiln process, redwood is said in effect to become flinty and capable of being broken into splinters over the knee.

The engineers having to do with wood pipe have not been altogether in agreement as to the matter of

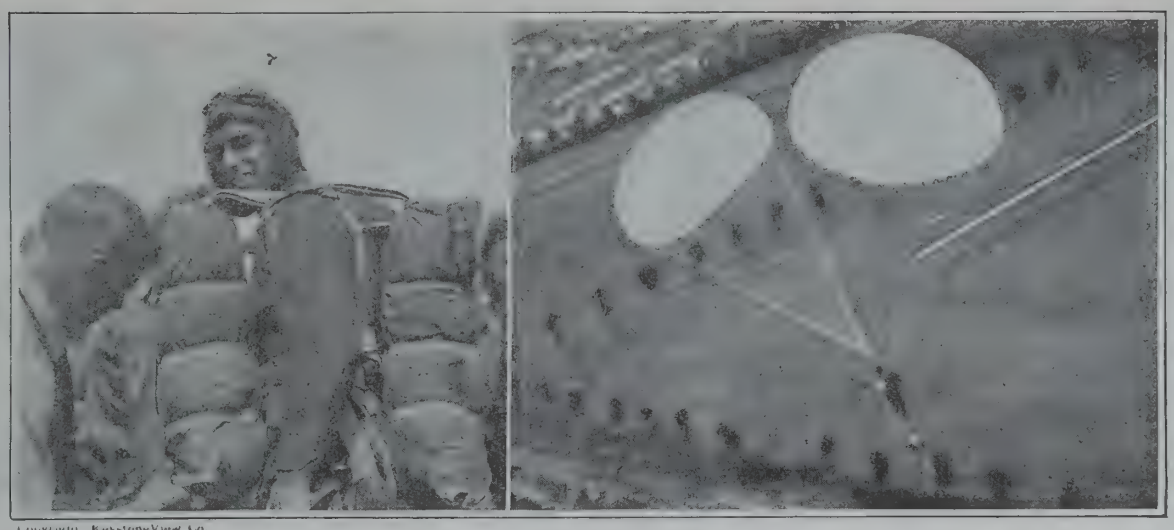
(*Continued on page 262*)

## Making Doubly Sure of the Parachute Jump

AVIATION is getting safer every day. Not only has the airplane been made safer in many different ways, but it is being equipped with parachutes for use in the event of an involuntary descent. And now comes the latest safety device for aerial travelers, namely, the double parachute which makes a parachute descent just twice as safe as with the conventional single parachute.

The United States Aviation Corps has been conducting a series of experiments with the new double parachute. Sergeant Gilbert A. Shoemaker, a veritable daredevil aviator, so we are told, has been using the double parachute with excellent results.

It appears that this device can be used either single or double at a time. If one parachute fails to open, which sometimes happens, the other by all the rules of probability should open. Again, if the descent is too rapid, the second parachute can be opened so as to lessen the rate of drop. The accompanying views show how the double parachute is worn by the aerial traveler and how it functions during a big drop of several thousand feet.



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**The double parachute worn by Sergeant Shoemaker, U.S.A., and how it opens up in a 5,000-foot parachute jump**

## Towing a Ship Across the Pacific

WHEN the tug "Hercules" on April 9th steamed into the harbor of Vancouver, Canada, towing the five-masted auxiliary schooner "Laura Whalen," a new Pacific Ocean towing record was established, one not nearly approached in many years in marine annals. The "Hercules" brought the schooner from the port of Papeete, Tahiti, in the South Seas, a total towing distance of 4,630 miles.

The "Laura Whalen" is one of a dozen five-masted schooners built of British Columbia fir which were constructed during the war specially designed as wheat and lumber carriers. Sailing on her maiden voyage on April 25th, 1918, a long series of disasters attended the ship. Lastly, after crew desertion, much engine trouble, she put into Papeete a few months ago with her rigging almost stripped, damaged engines and a ruined cargo of tallow, wheat and hides. The tallow had been carried as a deck load. Some of the casks became broached by storm. The hot South Sea sun melted the tallow which ran into the hold and mingled with the wheat. Having discharged her cargo and finally been pronounced unseaworthy to carry cargo, the "Laura Whalen," with fifty tons of ballast, was taken in tow on March 3rd by the tug "Hercules" and arrived in Vancouver on April 9th.

## Australia's Railway Gages

APPROVAL has been given to a proposal to give a uniform gage of 4 feet 8½ inches on the railways connecting the capital of the mainland Australian states from Brisbane to Perth. It is estimated that this will cost $120,000,000 of which the Commonwealth is to contribute one-fifth, the five states concerned finding the rest on a per capita basis. The Commonwealth line from Port Augusta to Kalgoorlie, 1,057 miles, which is one of the main links in the connection, is already on the 4 feet 8½-inch gage as are the New South Wales lines. Western Australia would have to convert 375 miles of 3 feet 6-inch line, Victoria 200 miles of 5 feet 3 and South Australia several hundred miles of 5 feet 3 inches, and 3 feet 6 inches, while Queensland would have to build 100 miles of new 4 feet 8½-inch line. It is also proposed to build several hundred miles of new line in New South Wales and South Australia in order to shorten the distance by rail from Brisbane to Perth, now 3,300 miles, by 469 miles. The conversion of the other lines in Australia to the 4 feet 8½-inch gage would be done later in piece-meal fashion. There are 22,046 miles of railway on the mainland of Australia, the proportion in the different gages being 5 feet 3 inches, 5,149 miles; 4 feet 8½ inches, 5,881 miles; 3 feet 6 inches, 10,866 miles; under 3 feet 6 inches, 150 miles. The cost of converting to the 4 feet 8½-inch gage all the lines not provided for in the $120,000,000 scheme recently adopted has not been estimated but would probably amount to $500,000,000.

## Again, the Water Bicycle Races

FRANCE has always been partial to new and odd methods of locomotion. It was France which first fostered the automobile when it was a feeble, balky, uncertain and unpromising thing; France placed her faith in the airplane even before the Wrights gave their practical demonstration of heavier-than-air flying; and now France is playing with water bicycles, winged bicycles and other toys, so to speak—but these are toys which may yet prove practical in the no distant future.

Another water bicycle race has just been held, this time at Enghien, just outside of Paris. As in previous contests of this sort, all kinds of queer contraptions participated in the race. Some contestants used craft driven by airplane propellers, others made use of the usual marine screw, while still others made doubly sure of their locomotion, so it would seem, by using airplane propellers and marine screws in combination. As luck would have it the simplest form of machine won. This machine, No. 5, driven by M. Bernard, won nearly all the races. In fairness to M. Bernard it is well to call attention to the fact that the driver, who must work the pedals as in bicycling, deserves just as much credit as the machine, if not more so.

The pedals of the water bicycle serve to drive the propeller or propellers, while the handle bars operate one or two rudders for steering purposes.

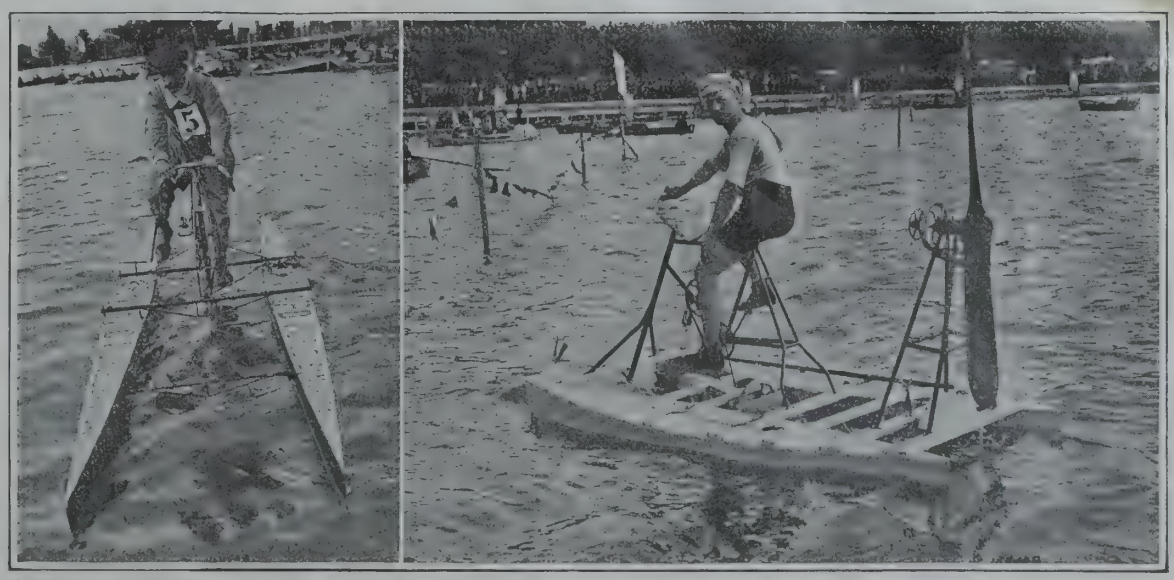
**This modified form of canoe, equipped with 15-horse-power engine, makes 25 miles per hour**

## Thermometer Deterioration

EVEN thermometers become old, and consequently inaccurate with age, mercurial instruments reading too high and spirit instruments too low. In the former case the bulb appears to shrink, thus forcing the quicksilver too far up the stem. This gradual shrinkage is supposed to be due to the fact that the external pressure on the bulb may be considerably higher than the internal pressure, the air as far as possible having been removed before the glass is sealed off. On the other hand, the spirit thermometer is sealed with the bulb covered in a freezing mixture, in order to lock up in the glass as much air as possible. The instrument thus starts with an internal pressure which in time appears to be reduced either by expansion of the glass under the internal pressure or by leakage.

## Turning the Canoe Into a Speedy Power Boat

EVERYONE is more or less familiar with the speed and easy-going characteristics of the canoe. And everyone has at some time or other come across the engine-driven canoe—generally a canoe equipped with a small gasoline engine of one-half to two horse-power. Now comes William H. Wray of Brooklyn, N. Y., with a modified form of canoe which he has equipped with a 15-horse-power twin-cylinder motorcycle engine. This odd power boat is sixteen feet long and carries three passengers. The engine drives the propeller by means of a chain. A speed of 25 miles per hour can be readily maintained.



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**Left: The winner of the water-bicycle races. Right: A contestant with his combination marine screw and airplane propeller machine**

## Technical Sponges

A SPONGE can be briefly defined as the skeleton of certain aquatic animals—naturally there are a number of varieties. This skeleton while being fairly strong when first used, gradually softens and breaks down through use and bacterial action. A patent for a tanning process has recently been issued to W. H. Allen of Detroit whereby the strength of the sponge is greatly increased and also increased resistance to bacterial action. The sponge is chemically in the same class of material as hides, and we know the lasting qualities of good tanned leather; therefore, it is to be inferred there is a good fortune for the tanned sponge.

*Left:* Testing the meter for accuracy with the automatic proving machine. *Center:* Pitting the indices of eighteen service meters against three master instruments. *Right:* Public Service Commission tester filling his proving machine to get the necessary gas to test a group of meters.

**Where New York's gas meters are proved to be accurate before they go into use**

# Checking Up the Gas Meter

## How New York's Consumers Are Assured That They Get What They Pay For and No More

By William R. Andrews

IN New York City about four thousand new and used gas meters are tested each week for accuracy, first by the gas company, then by inspectors in the employ of the Public Service Commission. The result of one test made not long ago showed a general average in favor of the consumer by 1.79 per cent. A similar low percentage became evident in the tests of 59,475 meters made by the Massachusetts Gas and Electric Light Commissioners. The figures of the Board revealed the fact that only 206 of these meters were inaccurate. A few were fast, and those that registered slow were found to average 3.78 per cent over the average of the fast meters. Here again the results favored the consumer.

The gain by the public through such percentages as these is due to legislative enactment in the various States where commissioners have been appointed to supervise the relations between public utilities and the consumer of gas, water and electricity. For instance, in New York State gas meters are not allowed to run over one-half of one per cent fast, a trifling gain for the companies. The net result is so small that the tolerance may be compared to the one-eighth of an inch variation in a mile allowed a civil engineer in running a line for railroad trackage. It is pretty evident that the "gain" is almost infinitesimal in both instances. But there is still another factor to be reckoned with—the commission permits a meter to run two per cent slow. Thus the consumer whose meter fails to register correctly in this particular is the gainer, and by legal cognizance. If on test this discrepancy in the action of the meter is found the gas company cannot collect arrears. On the other hand a rebate is allowed if tests show a meter has been running fast.

Notwithstanding the advantage to the consumer in the few instances of meter variation in his favor, the law governing such cases was not passed with any idea of favoritism. The purpose was to meet the exigencies of certain mechanical contingencies which might affect the equitable distribution and sale of the company's product and its payment.

Curiously enough these statutes safeguard the consumer in a way he little realizes. The ancient law of *caveat emptor*, which governs the purchase of practically everything except electricity from a public utility corporation, seems to have become inoperative in his case. For, as gas is standardized in quality and fixed in price by law, he does not, when dealing with a gas company, buy at his own risk. As to electricity, the parallel applies only to the price-fixing by public service commissions. Everyone knows, of course, that there is no such thing as a possible variation in "quality."

All meter tests in New York City are conducted in the meter and appliance repair shops of the gas company at 111th Street and First Avenue. The building is 100 by 200 feet and is ten stories high. The meter department however occupies only three floors. The rest of the premises is used for general repair work, the storage of material and the testing of gas appliances—stoves, heaters, ranges, etc.

The overhauling of 4,000 meters a week is no slight undertaking and the cost of the meter tests is borne solely by the company. A considerable force of workmen is maintained and the burden of expense is not lessened in these days of plutocratic labor when an experienced meter tester draws a wage of $60 a week.

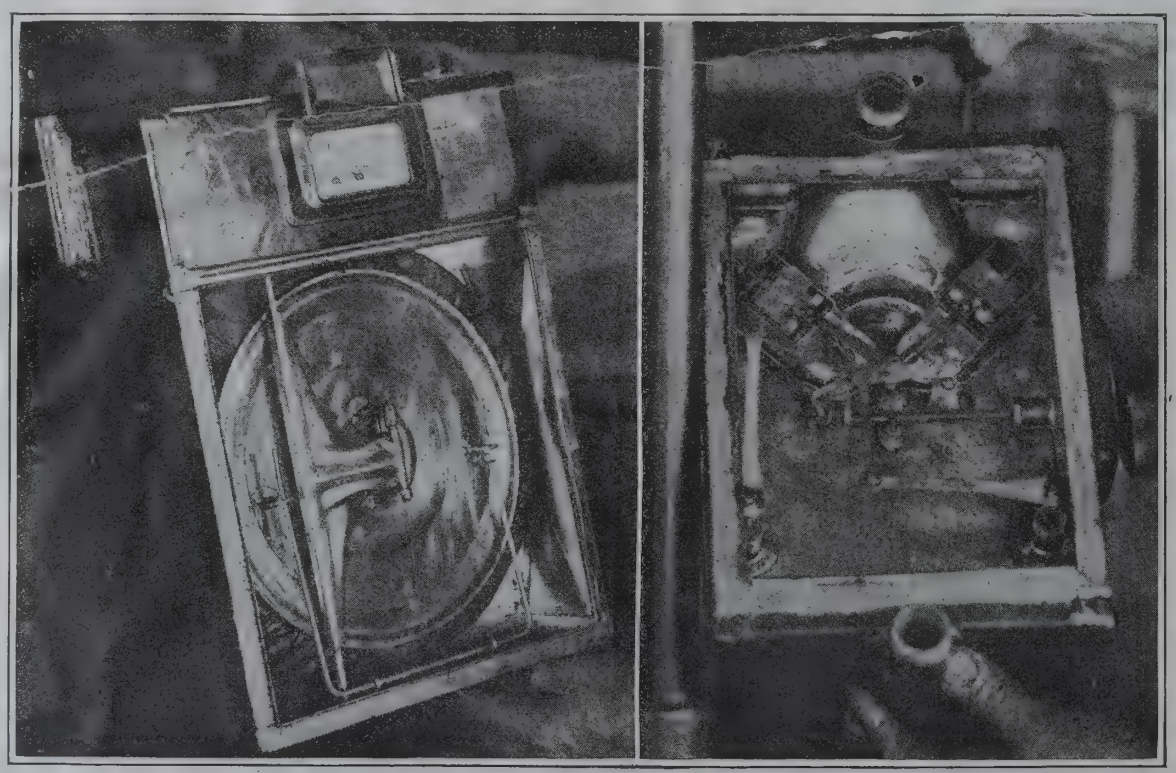
Meters to be tested or in need of repair are first sent to the central collection stations of the districts in which the company has divided the city. Thence the meters go to the 111th Street building and are sent upstairs to the testing department on trundle trucks in lots of 200 or less. There are eighteen sizes, ranging from the three-light meter to those which measure the gas consumed by 300 burners. Only a small portion of the meters received are sent to be tested at the instance of the consumer. The majority have been taken from apartments, private dwellings, stores, office buildings, shops and places of amusement in accordance with a prescribed routine. Experience shows that the wear and tear on the mechanism makes it necessary to remove a meter for repairs after six years' service. The overhauling and testing operations number thirty-two and cover a period of three weeks.

For the initial test an instrument called a meter prover is used. This consists of a large metal tank, filled with water, three and a half feet in diameter and about as high as a man's armpits. A cylinder of galvanized iron is suspended with a counterweight from a wheel at the top of a metal frame secured to the rim of the tank. The upper part of the apparatus towers considerably over one's head. Thermometers, a syphon pressure gage and a hose are the principal parts of the equipment. The gage is used to detect leaks, and a vertical metal scale on the cylinder shows any deviation in the meter's registering device when the gas used in the test moves the cylinder up and down in the water.

Besides these machines there are in use on the same floor several automatic provers invented by Marshal Cornine, the superintendent of the meter and appliance shop, and installed about 12 years ago. His invention saves considerable time. For instance: The tangent connected with the top dial over the indices on the front of a meter is set to make one complete turn to register two cubic feet in the tests. On the old style machines the tangent must be run twelve times. But the same result is obtained on a Cornine prover with one revolution of the tangent. The automatic provers are used for the smaller meters and the other type for the large sizes. All the provers are inspected by Public Service experts, who place the seal of the commission on each prover as it is shown to be correct in its operations.

A complete record is kept of every meter brought to

(*Continued on page 264*)



*Left:* The bottom of the gas meter, as it appears when opened to see whether the diaphragms are properly flexible. *Right:* At the top of the meter, where valves must be clean and in place, gears properly meshed, and stuffing boxes tight.

**Investigating the internal workings of the gas meter**

## America's Bid for the Gordon Bennett Cup

**By Austin C. Lescarboura**

AFTER all is said and done, it is the spectacular side of aviation that appeals to all of us—at least to all of us who are interested onlookers; for the aeronautical engineer and the man who has invested his money in winged travel are interested in a collection of facts and figures which mean little if anything to us. The greatest altitude, the fastest flight, the longest sustained flight—these achievements represent to the layman the momentary status of aviation.

So, speaking in the layman's language, we are to have an exposition of what has been accomplished in airplane design and construction during the past decade or so. The great international race for the Gordon Bennett Cup is to be staged in France on September 27th, and there is little doubt that the world at large will be astounded at the bursts of speed of many of the contending machines. It is only a short while ago that the first aerial meet was held at Rheims, where, on August 29th, 1909, Glenn H. Curtiss, piloting a Curtiss biplane with a 50-horse-power engine, beat the Frenchman, Bleriot, by six seconds over a twenty-kilometer course. He had traveled at a rate of 46.5 miles an hour.

In the coming contest no machine which cannot attain a speed well over 200 miles an hour need be entered. It would be ludicrous to enter such a "slow" machine. Again, it seems that any machine with less than 250 horse-power has no place in this coming race; indeed, we shall no doubt witness machines with as high as 600 horse-power engines participating. It has been rumored that some of the European contestants may employ engines of 1,000 horse-power!

The race is to be held at Etampes, near Paris, over a circuit course of 300 kilometers (about 180 miles). The start and finish will be at Etampes. Many monetary prizes are offered, aside from the Gordon Bennett Cup, which goes to the victor. Great Britain, France, Italy and the United States are among the twelve entries. While Germany is barred from this contest, it is rumored that German aircraft constructors have entered several of their machines through the neutral countries, most likely Holland, Denmark and Sweden. One feature of this great race is that pilots may use their own fuel. Thus it becomes possible for the contestants to resort to various synthetic fuels which have been developed for aviation purposes. It is understood that the Dayton-Wright machine will use synthetic fuel. Again, supercharger equipment is permitted, and no doubt more than one contestant will make use of this latest device for ensuring maximum engine efficiency. Hence this race becomes a real and fair test of the machine, the engine and the fuel, as well as the pilot.

Three machines have been entered by the United States for the great race. Two of the three machines are monoplanes, while the third, the Army Air Service entry, is a biplane. All three machines have been designed around some particular engine instead of the usual practice of fitting the power plant to the plane. And each machine has made better than 200 miles an hour in test flights, which speaks well for America's chances of winning the much coveted trophy.

First of all, let us consider the Curtiss monoplane. Here is a machine which is every inch a racer. The pilot's seat is far in the rear part of the body, as will be noted in the accompanying illustration. In fact, it is two-thirds of the distance from the nose to the tail. The monoplane is provided with a short and stubby propeller with stream-lined hub or "pot." The wing is very thick, and is braced on each side of the body by a single thick strut slanting down to the hub of the landing wheel. The radiator is arranged on either side of the body as shown, so as to reduce the head resistance to a minimum. The engine is a twelve-cylinder Curtiss type, developing 400 horse-power.

**The Curtiss monoplane racer, equipped with 400-horse-power engine. Note the position of the cockpit, two-thirds the distance back from nose to tail. Also note the radiator on the sides, so as to reduce head resistance**

### TABLOID HISTORY OF THE GORDON BENNETT CUP CONTESTS

**1909—Glenn H. Curtiss (American), winner. Race held at Rheims, France. Speed attained, 43 miles an hour. Curtiss biplane, 50-horse-power.**

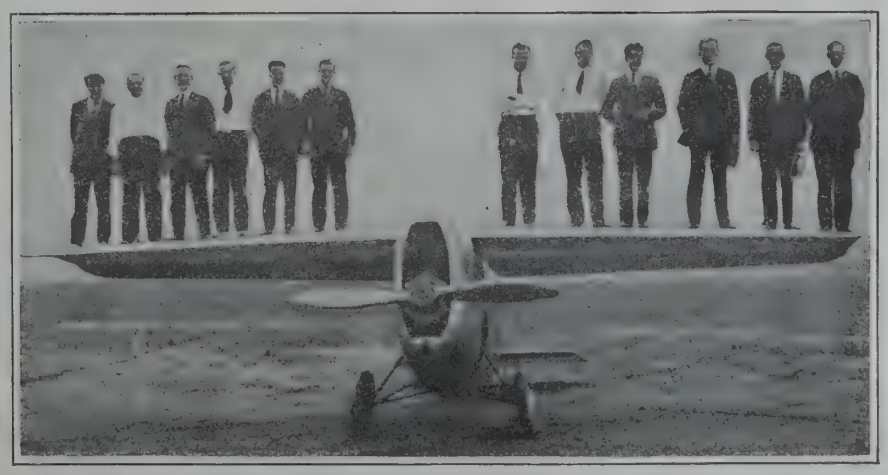
**1910—Grahame-White (British), winner. Race held at Belmont Park, Long Island, U. S. A. Speed attained, 61 miles an hour. Bleriot monoplane, 100-horse-power.**

**1911—C. T. Weymann (American), winner. Race held at Isle of Sheppy, Eastchurch, England. Speed attained, 78.1 miles an hour. Nieuport monoplane, 70-horse-power.**

**1912—Jules Vedrines (French), winner. Race held at Clearing, Illinois, U. S. A. Speed attained, 105 miles an hour. Deperdussin monoplane, 160-horse-power.**

**1913—M. Prevost (French), winner. Race held in France. Speed attained, 126.59 miles an hour. Deperdussin monoplane, 200-horse-power.**

**The Verville-Packard biplane, equipped with 500-horse-power engine. Unlike the Curtiss monoplane, the pilot here is pretty well shut in. This machine has the latest Packard engine which develops unusual power**



**The Dayton-Wright monoplane, equipped with 250-horse-power engine. The wings are rigid cantilever structure, made up of three-ply veneer. The landing gear can be pocketed on either side of the body**

This Curtiss monoplane is being entered by S. E. J. Cox, president of a Texas oil company, and millionaire sportsman. It is known as the "Texas Wildcat." In a recent test flight the machine developed 223 miles an hour, breaking the world's speed record by a safe margin. The monoplane has been built in duplicate, so that if anything happens to the first machine the second will be used. Roland Rohlfs and Clarence Coombs, record-holding aviators, will pilot the Cox planes in the cup race.

The Army Air Service is known as the Verville-Packard and is of all-American design and manufacture throughout. It was designed and built by the Packard Motor Car Company under the guidance of Col. J. G. Vincent, who also designed the engine. [A complete description of the 500-horse-power engine installed in this plane was described in our issue of September 4th, 1920, on page 226.] The engine has a total piston displacement of over 2,000 cubic inches and weighs approximately 1.94 pounds per horse-power, representing a distinct forward step in aircraft power plants.

The Verville plane was designed and constructed especially for this engine, but it is, however, in no way a freak racing machine. It is built for both service and production. The plane itself has been developed by the engineers of the office of the Chief of Air Service at the Engineering Division at McCook Field. It is felt by the Army men that in the face of the terrific speeds which will undoubtedly be shown by all planes entered in this year's event, the Army Air Service has an excellent chance to win. Captain Rudolph Schroeder, present holder of the world's altitude record, will pilot the Army plane.

The Dayton-Wright monoplane measures only 22½ feet from wing tip to wing tip. Its body is 12 feet long. The wings are of rigid cantilever construction. Instead of being covered with fabric, they are made of three-ply veneer. When the little machine is in flight the wheels and the entire landing gear are drawn up inside the body and the machine presents the appearance of a gigantic steel projectile darting through space at more than three miles a minute.

It is this retractible chassis, or landing gear, wing structure, and what is known as a variable camber or wing curve that make the Dayton-Wright a remarkable contestant for world speed honors. While technical details have necessarily been withheld, pending the race, it is known that a crank in the instrument board of the machine enables the pilot, after he has left the ground, to raise the wheels and landing frame into the fuselage, and at the same time using the same mechanism, automatically to flatten out the wing. The whole process requires only from 12 to 15 seconds. It requires even less time to drop the wheels and restore the wing curve in landing.

The curve in an airplane wing affects the speed at which the machine takes off or lands, but it also retards or accelerates its speed while in the air. For instance, the curve of the wing enables it to take off more quickly and land at slower speed, thus requiring a smaller field and eliminating danger in landing in an emergency. By evolving a means whereby the wing curvature can be altered at will, the Dayton-Wright designers have been able to decrease the landing speed to twenty miles an hour, and increase the racing speed in the same ratio.

By drawing up the landing gear and

*(Continued on page 266)*

# The Service of the Chemist

*A Department Devoted to Progress in the Field of Applied Chemistry*

Conducted by H. E. HOWE, Chemical Engineer

## Radium in Medicine

IF purchases can be taken as an indication, it would seem that medical men are approaching unanimity of opinion with reference to the use of radium, which at one time was held to be without value by at least one important group. Recent purchases of $120,000 worth of the rare element by medical men in a single month indicate the tendency and emphasize the necessity of conservation.

It is estimated that there have been between 105 and 110 grams of radium recovered from the ore thus far, of which 70 grams were from American ores. The European reserve stocks were practically exhausted for war purposes, being used principally for luminous dials and elsewhere in forms which mean its absolute loss to science. There are probably between 20 and 22 grams in the United States at the present time, part of which is that owned by the Bureau of Mines and loaned for medicinal purposes. The necessity for conservation becomes more evident when it is understood that the ore bearing the radium occurs in pockets, that the surface pockets have been practically exhausted, and that future supplies must come for the most part from those pockets which can be located by drilling. It is evident that this carries a considerable degree of uncertainty and while authorities differ as to the amount of radium that will possibly be recovered from now on, conservative estimators place it at a total of 100 grams.

## American Analytical Balances

A CONSIDERABLE percentage of the demand for analytical balances is for the type which has a definite sensitivity of one-tenth of a milligram under the full load of 200 grams in each pan. This type of balance has been successfully made by American methods, which means quantity production. One of the well-known manufacturers believed he could effect certain improvements if it were possible for him to obtain orders justifying new jigs and tools, and an order for 1,000 from a single progressive dealer was sufficient to guarantee the new work. An order for so many analytical balances of one type was something new in scientific apparatus of this character, but the result has been a moderately priced balance which meets the requirements of industrial chemists and many of the educational institutions.

## Tin Recovery

THE recovery of tin from scrap has engaged the attention of several chemists, especially since the demand for the tetrachloride of tin has been increased by the rapid growth of the use of silk. A new process has just been patented in which the scrap tin is first treated with a strong solution of sodium hydroxide at from 120° to 150°F. in an iron tank lined with graphite or some other material electro-negative to tin. The galvanic action set up between the graphite and the tin accelerates the solution of the tin, and the operation is repeated with various batches of scrap until the bath is rich in tin. The solution is then placed in a second iron tank and bales of scrap tin are suspended in the bath and a current passed. The tank acts as the cathode and the tin becomes the anode. In this process the tin from the bale is dissolved and deposited, while the tin is also deposited from the bath itself, so that it can be returned to the first tank and re-used.

## Graphite from Kish

THE story of how artificial graphite produced from anthracite or petroleum coke by electrolytic methods employing Niagara power has gradually replaced natural graphite, is well known. Natural graphite has held its place principally in the manufacture of large crucibles, but recently patents have been issued covering methods of manufacturing crucibles in which artificial graphite is an important ingredient. The output of artificial graphite has risen very rapidly, and from 1915, when it reached five million pounds, it increased to ten million pounds by 1918. Much of it finds its way into lubricants, paints, battery fillers, foundry facings, and boiler scale preventatives.

Attention has recently been called to the possibility of recovering graphite from the mixture of that substance with slag, iron oxide, fragments of iron, etc., which accumulate about a bessemer or open-hearth furnace or casting ladle, and known as *kish*. The graphite is formed during cooling by the crystallization of the excess carbon from the molten iron, and the graphite, which may reach 8-10 per cent, is in the form of light, thin flakes. If the mixture containing the graphite is carefully screened and treated with magnetic separators, the graphite may be concentrated and refined. The supply is probably not great enough to present a commercial possibility at the present time, but may form a worth-while source in the future.

## Flotation Applied to Fuel

THE experiments which have led to the perfection of the Trent process for the treatment of coal illustrate again the success which often attends the application of processes peculiar to one field to the problems in another. Certain types of coal carry their ash in a form sufficiently segregated to make it possible to separate it by ore flotation methods. This removes about eighty per cent of the ash and gives an oil-coal fuel possessing desirable characteristics. If advantageous, the oil could be recovered. One of the best features of the process is the possibility of reducing the coal to a fineness sufficient to pass a 200-mesh sieve by wet grinding methods, thus eliminating one of the principal hazards in the use of powdered coal, namely, the liability to spontaneous explosion of the very fine dry carbon dust.

## Experimental Coal Mines

DR. J. J. RUTLEDGE presented an argument in favor of demonstration coal mines before the American Institute of Mining and Metallurgical Engineers at their February meeting, urging the importance of such mines if the most is to be made of the technical skill that can be employed in solving the problems of underground coal mining. Some of the experiments which could be tried are: Satisfactory methods of stopping the slacking of mine roofs during the summer; determining the best method of mining in a particular field; developing better methods of timbering; a study of proper explosives; mining machines; methods of haulage; ventilation; generation and distribution of power; efficient pumping; greater safety in shot-firing; and a testing of the roof or bottom shale in metallurgical plants or in the manufacture of brick or terra cotta ware.

## Carbon

THE work on special charcoals for gas absorption in gas warfare defense has brought to many a better appreciation of the differences in charcoal and other forms of carbon. The field offers a wonderful opportunity for research of the most profitable kind, when the usefulness of carbon for clarifying and decolorizing is fully considered.

Lately a number of laboratories have undertaken the problem, their work differing in the raw materials as well as in method. Rice hulls, kelp, and lignite are some of the raw materials used. The premium which we pay because we have not been sufficiently interested in developing suitable decolorizing carbons is illustrated by the fact that one foreign company has met with much success in first licensing the use of their carbon at $5,000, then selling the material at $500 per ton, and in addition receiving a royalty of thirty cents for each 100 pounds of material decolorized with this secretly prepared carbon. A number of concerns use the material even under these conditions, and the prize should be enough to attract some of our best physical chemists.

## Motor Spirit

THE *Journal of Commerce* reports a new process for the extraction of commercial alcohol which, though still in the experimental stage, is said to be capable of producing a satisfactory motor spirit. The work has been carried on in England, where alcohol and derivatives have been recovered from coke oven gas by a sulfuric acid contact process. An average yield of 1.6 gallons of alcohol per ton of coal carbonized is reported and it is calculated that if all of the coke oven gas from the coal reduced to coke in England during 1918 had been subjected to this process, more than 23 million gallons of alcohol would have been recovered.

## Non-Coking Coals

EXPERIMENTS conducted at the University of Illinois on low temperature carbonizing of coal have been reported to the American Institute of Mining and Metallurgical Engineers, and while the work has really but begun, the indications are that the so-called non-coking coals of Illinois may be advanced one of these days into the class of coking coals. Working at 750°C., the gas produced was high in calorific value and the tars were of unusual interest.

## Methanol

IT has been pointed out before that in view of the importance of wood alcohol to the chemical industries, the legislation which might be enacted as the result of its use as a beverage became a subject for serious consideration. In the belief that the names wood alcohol and methyl alcohol were partly to blame, a change has now been agreed upon so that hereafter this article of commerce will be known as methanol.

## Aircraft Dope

FOR some time "dopes" made from cellulose acetate have had the preference for coating fabric used in aircraft production. It is more expensive than materials composed of cellulose nitrate since in their manufacture acetic acid and acetic anhydride are required and these raw materials are more expensive than those employed in the nitration of cellulose. However, the acetate is fire resistant or slow burning and that has given it a decided advantage. It has now been found that some five to eight per cent of ammonium magnesium sulfate when added to the nitrate makes it fire resistant, since when ignited a quantity of ammonia gas is given off extinguishing the flame.

## Furfural

FURFURAL is another of those substances upon which comparatively little industrial work has been done because of its scarcity and price, which made it out of the question for manufacturing purposes. Few industries could afford to pay $17 a pound for raw material. In attempting to use a part of our annual crop of corn cobs, it has been found that furfural is one of the materials that can be prepared, either as the principal product or as a by-product, and costs as low as ten cents per pound have been realized. At the Bureau of Chemistry it has been found that furfural may become the starting point for a large number of dyes which may become as important as one of the series now obtained from coal tar products. It may be condensed and, experimentally, a fast brown dye has been made by treatment with sodium sulfide for wool and silk, and with ammonium sulfide for the direct dyeing of cotton. The stimulation of such valuable research is sure to follow from the establishment of our organic chemical industries, but without encouraging legislation this will be impossible and development which often produces values in unexpected places will be stifled.

## Carbon Black

CARBON black is a fluffy, velvety pigment, usually produced by burning natural gas with a smoky flame against a metal surface and the product is entirely different from lamp black, with which it is sometimes confused. Lamp black is gray in comparison with carbon black and in all places where carbon black is used lamp black is practically an unsatisfactory substitute. In normal times we have been in the habit of exporting about 15,000,000 pounds and besides this have used in printers' ink ten to twelve million, rubber goods, twenty million; stove polish, four to five million; and miscellaneous, one million pounds annually.

The Bureau of Mines has undertaken an investigation of probable sources of lamp black and with the gradual lessening of our natural gas supply the question of carbon black may become a rather serious one. The present methods are known to recover but a few per cent of the carbon in the gas, and developmental work on efficient methods of production from natural gas and other possible materials is in order. The thermal decomposition of gas or other hydrocarbons with insufficient supply of air, or explosion with carbon monoxide, carbon dioxide, oxygen or their mixtures has been suggested.

*Left:* Making a feast from a half-rotten potato. *Center:* View, a little over half size, showing clearly the mantle and breathing pore and the two pairs of horns or tentacles, with the eyes in the tips of the longer pair. *Right:* Stuffing himself with the foliage of the chrysanthemum

**Some close-up views of the garden slug, with special reference to his major occupation of eating**

## A Queer Visitor in the Garden

**By Hamilton M. Laing**

HIS book name is Ariolimax columbianus, but he is better known as just plain "big slug." He *is* a big slug—almost unbelievably big when first we meet him. He attains a length of seven and a half inches and a thickness greater than that of a man's thumb—a veritable leviathan of his kind. When we meet him stretched out on his way across a woods path or find him clinging to vegetation far from the ground, he is like something seen only in the nightmares of a small boy.

In general appearance this slug is like a huge snail minus his shell. Instead of a shell on his back he carries merely a mantle and his single breathing pore is through the right side of this mantle. His eyes are perhaps his most peculiar feature: he has a double set of "horns" or tentacles, the front pair short, the hind pair much longer and in the tip of this rearward pair are his eyes. He can "pull in his horns" in very truth and the eye comes too—periscope and feeler in one. Also, each tentacle works independently of the other. His color is tawny green and his back usually is more or less mottled with brownish—just the combination to hide his slow-creeping form from prying eyes that might be peering about in the shadows of the moss-green woods.

A most interesting thing about him is his manner of getting over the ground. When extended and on the march his body seems magically to slip forward; we have to look closely to mark his steady progress; the slime trail behind him is best evidence. Though he has no legs he does not wriggle forward like a snake. His under surface really is his "foot" and he is glued to the ground, this flat member sticking tight and secreting the slime that marks his path. He moves forward in sections. His head and foreparts extend momentarily and after them in a series of minute ripples come the more rearward segments. In this way he can climb any obstacle from the spiny bark of the devil's club to the surface of a pane of glass. Timed and measured on a woods path he has been found to make two and one-half inches in two minutes or six feet three inches in an hour. Yet the scientists say that this slow-going chap came to Oregon and California from Asia, by way of Alaska; and that he walked!

The slimy trail glittering in the morning sun upon the cement walk or on the earth in the garden is the unfailing sign that Ariolimax has left the woods and come for a visit. When he is traveling extensively the amount of this mucilage he has to manufacture is considerable. Why he does not become permanently glued down with his own adhesive is one of Nature's mysteries; for when the mixture is taken between the fingers and worked half dry it has the stickiness of commercial glue. Doubtless one reason for the slug's dislike for the sun is that he is in danger of being dried up and cemented down.

Usually one of the interesting things about a creature is its food and it is over the food question that this big slug comes into closest touch with man. He comes out of the woods and into the garden for a purpose. His appetite is tremendous and there is little that he will not devour from a whole row of new lettuce to the top sprays of the tall chrysanthemums. What he eats seems to depend on circumstances; for when his expedition lands him on the lawn he accepts

(*Continued on page 268*)

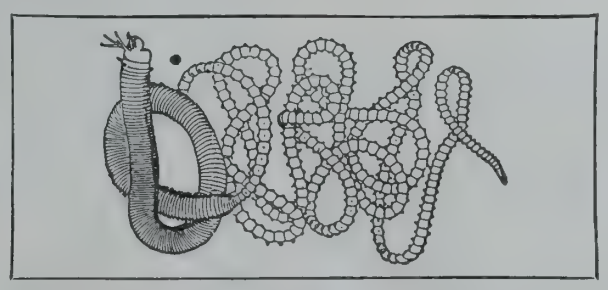
## Ships for Sheep

THANKS to that Western ingenuity which has so frequently overcome extreme obstacles, a three-decked barge has been devised for transporting sheep from winter to summer pasturage on the Chelan National Forest, Washington. The time element in moving 3,000 head of sheep has been reduced from 15 days to 15 or 20 hours.

**Big barge for moving sheep from winter to summer grazing grounds**

The accessibility of Lake Chelan, 3 miles wide and 50 miles long, renders practicable the use of a barge in hauling the livestock. Formerly, the sheep were driven overland from the winter to summer grazing territory, the tedious journey of 15 days through rugged mountainous areas proving disastrous to many of the lambs.

A gasoline boat propels the three-decked equipment,



**The palolo worm of the South Pacific, showing the rear portion that breaks off**

which was specially designed for the purpose. About 1,000 sheep are carried on each trip, the expense being 12 cents for each head. The barge is a connecting link between summer and winter pasturage, the sheep leaving the winter range country in the spring only to return when the leaves again assume a tint of hue in the fall. The lake itself is at an elevation of 1,800 feet above sea level, and is a dividing line between varying areas as to climatic conditions conducive to luxuriant pasturage.—By *S. R. Winters.*

**A moat designed to protect garden plants from slugs**

## Headless Worms—A South Sea Delicacy

EVERY year in October and November enormous swarms of the so-called "palolo" worms suddenly appear on the day before the last quarter of the moon along the coasts of the South Sea Islands. The natives await this event with keen interest, since they highly esteem these worms as a delicate tit-bit whether eaten raw or roasted. It is said, too, that Europeans who have succeeded in "acquiring" a taste for them find them very palatable and appetizing. It has long been noted that these creatures were always headless and this circumstance has now been explained, says a writer in *Kosmos* (Stuttgart), by the fact that the palolo worm is really only half a worm! In other words it is the rear portion of the body of an annular worm, the *Eunice viridis*, which finds its habitat in the crevices of coral reefs. This curious creature has its body divided into two sharply defined portions, as shown in the accompanying illustration. The essential part of the animal is the upper portion of the body, consisting of thick broad "rings," while the lower portion or "tail" is composed of much smaller annular segments. This part of the body, which may reach a length of 50 cm., is devoted to reproductive purposes. At the period of sexual maturity this section of the worm, which is filled with sexual products, breaks away from the main portion of the body and rises to the surface of the water, where it swims about for a time and then gradually separates into its segments, which discharge their contents into the water, thus fulfilling their function. Meanwhile the parent animal peacefully leads its obscure existence in the rifts of the coral reef and proceeds to grow another "tail." This is a typical example of the self-crippling capacity so often seen in the animal kingdom, and shows what an important biological function this peculiar power may serve. In this case, of course, the principal purpose is the extension of the territory in which the worm exists, since the lightness of the rear portion of the body enables it to float far and wide from the place of its origin.—By *M. Tevis.*

## Novel Plant Protection

IN the case of a rock garden, which contained a number of valuable Alpine plants, much trouble was experienced from slugs. Some important specimens were badly damaged by the pests and all ordinary means of keeping the enemies at bay were without avail. A plan which met the difficulty is pictured.

All around the garden a ditch was opened up. This was about 9 inches in depth and 7 inches in width. Strips of sheet zinc 20 inches wide were then secured. These were bent around in a U shape. The ditch was lined with cement and the zinc trough placed in position as shown, with the cracks cemented over so that the whole arrangement was water-tight.

When the garden was completely encircled with the zinc trough water was poured in. In this way the rock garden was completely cut off from the surrounding area. For a few days a thorough search for slugs was maintained among the Alpine plants. When all these had been destroyed there was no further trouble with the pests seeing that none of the creatures was able to cross the water barrier.—By *S. L. Bastin.*

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

This device brings the emergency brake lever fully 6 inches nearer the driver's hand

## Bringing the Emergency Brake Within Reach

A NEW device introduced by a Los Angeles firm brings the emergency brake handle within reach of the driver without the tiresome groping and stretching for the iron handle.

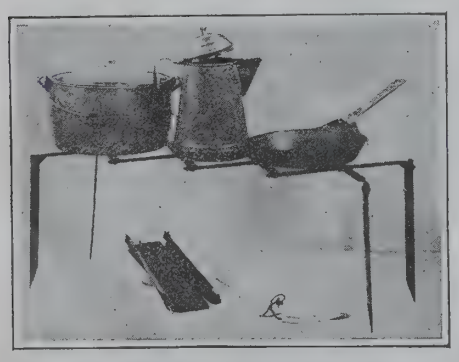
The device trips the ratchet of the emergency brake by means of a release which operates with the same movement of the hand that sends the lever backward or forward. The ball grip is easily grasped and the lever is, in reality, brought six inches nearer the operator's hand by using the device.

## Radio Banking Service

IT is reported that wireless banking is a success aboard the ex-German liner "Imperator." The Cunarder has established the first sea bank with a safe large enough to carry a huge amount of cash. Drafts on shore banks are honored and the money transferred by radio.

## A Camp Grate That Folds

WHEN this camp grate is folded it is only four inches wide and twelve inches long, with a weight of five pounds. When it opens it has a cooking surface of 36 inches, and will support three large cooking utensils.



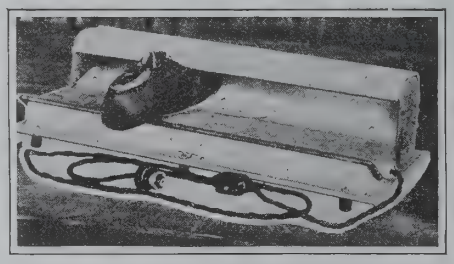
This camp grate can be folded into a small bundle 4 inches wide and 12 inches long

## Reclaiming the Barren Land

IN order to reduce the scarcity of food on the one hand and to increase the land available for settlement on the other, the German Government has suddenly turned its attention to the reclamation of barren lands. The area of barren land yet to be found in Prussia alone is estimated at not less than 3,705,000 acres. Between 1850 and 1918 approximately 1,970,000 acres were brought under cultivation. A further 3,705,000 acres of rich soil is yet to be obtained by drainage.

## A Stove That Softens Shoe Toes

THIS is one of the improved electrical devices used in the shoe business. It will not burn leather, yet it softens the toes and speeds up production. The shoe is placed right side up with toe of last under the shelf. An adjustable rod on top holds back the vamp keeping the box toe flat on the slab. Heat is regulated by a thumb switch. It is not necessary for current to be turned on continuously as when the asbestos slab is hot it will retain heat for some time without current. It requires but a very few minutes to soften the shoe toe so that it can be lasted by hand or on a machine.



The toes of shoes are softened in this small electric stove

## The Tilting Table Saw

AS the term "tilting table saw" implies, the force of gravity is capitalized in chopping wood by pivoting the table to the lower portion of the frame and so constructing that when a cut is finished the downward tug will pull the table from the saw and into position for moving the wood up for the succeeding cutting performance. The design is especially adapted to cutting cordwood or short chunks—frequently phrased as "stovewood length."

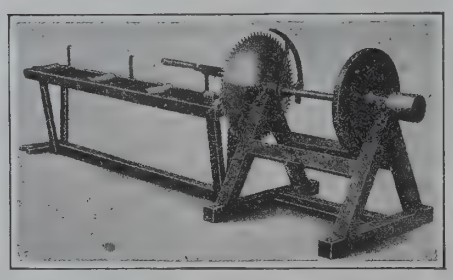
When designed exclusively for cutting cordwood, the table is constructed immediately in front of the saw mandrel, the uncut portion of the wood passing between the flywheel and the saw blade. The severed chunk then can fall directly to the ground, eliminating itself for the succeeding cut. The saw mandrel is less than 4 feet in length; and if the flywheel is stationed on the saw mandrel, poles or other lengthy pieces of wood cannot be placed on the table without coming into contact with the flywheel.

Consequently, tilting-table frames designed for chopping pole wood are of a varying construction. The flywheel is mounted on another shaft, permitting its operation below the table, or the latter is stationed on the side of the saw blade away from the mandrel. Such an arrangement permits of the wood being fed to the saw from the outside.

## A New Wheel Guard for Railroads

A NUMBER of men prominent in railroad circles and other men who preside over safety departments, got together in a northern Ohio town not long since to witness actual tests of the new guard which is attached to the front end of cars and extends to within a few inches of the rails. All tests were made with a dummy, weighing as near as possible the average weight of men employed as brakemen, switchmen and in other railroad capacities. In all tests, at which time the dummy was placed in positions resulting from falls from moving trains, the guard cleared the track of the obstacle, and in only one was it injured. This was in a case in which the dummy sat upon the tracks, and was passed under the train between the wheels, uninjured with the exception of having its overalls torn and scratched.

The guard itself is a forged bar of steel curved to conform to the shape of a car wheel. The upper end is T-shaped which provides means for bolting it to the carbolts of the underframe. The lower end holds a slipper. Normally this balances, but when an object is forced against it, it drops to the track and clears off any obstruction. It will not only be the means of saving lives of railroad men, but will prevent train wrecks caused by obstacles falling across the tracks. A large railroad tie was placed in such a position, and as it came in contact with the guard it was thrown aside and the train of several cars passed in absolute safety.



A tilting saw table which simplifies and speeds up sawing

## Saving the Heat That Goes Up the Chimney

IT is a well-known fact that with the fuels at our present and past disposal we are, as we have been, highly extravagant. So far as the consumer is concerned, to be sure, this extravagance is often involuntary, being attributable to furnace, stove and oven design that makes impossible the full utilization of the heat produced. In particular it is quite usual to have the gases that pass off up the chimney carry with them several hundred degrees of heat, which has not been utilized in any way.

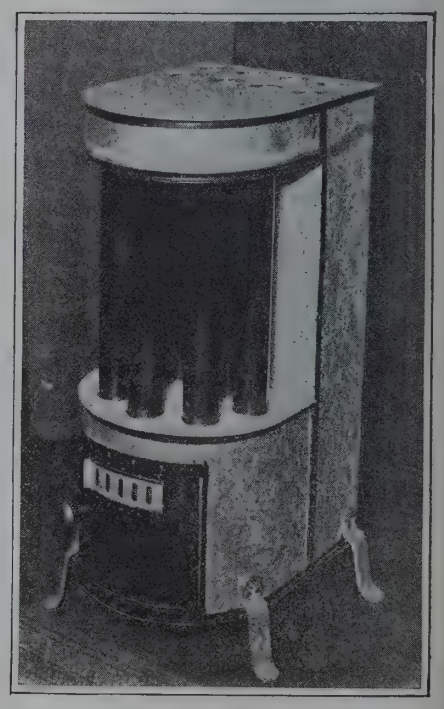
In the effort to use to the full the heating power of the conventional briquettes, a German manufacturer has placed on the market a briquette stove constructed on a new plan. The stove in question takes briquettes of brown coal or turf, and will likewise burn artificial fuel of various sorts, made from coal and coke tailings, etc. It is claimed that three briquettes will heat a room of moderate size. It is in some use as a sort of preliminary warming medium for rooms in which the temperature is later to be maintained by the rather more economical but not nearly so effective tile stove which has for so long been the bane of travelers in Germany.

These simple wheel guards are attached to railroad cars for safety's sake

The trick of this stove is the passing of the gases of combustion through the several heating chambers before they go to the chimney. They are allowed to retain only so much of their heat as is necessary to insure a good draft. Utilization of the heat heretofore carried off by these gases is effected through a quantity of tubes, arranged vertically in the chamber, and affording the necessary absorbing and radiating surface. The tubes are open above and below, and the gases pass freely through them and to the chimney. Effective radiation of the heat is assured by the exposure of the surface of these tubes to the room atmosphere, as indicated in our illustration.

## Canada and Carbide

THE manufacture of calcium carbide at various points throughout the Province of British Columbia is being strongly advocated these days. This material, which is manufactured from limestone and coke by subjection to heat in an electric furnace, is used for the production of acetylene gas, as a substitute for gasoline, and for certain chemical purposes. One ton of calcium carbide is obtained from 3,000 pounds of the mixed material.



German stove with unusually large radiating surface

# *The Farm Electrical—*
## *bigger crops, greater comforts*

WHAT farmer has not dreamed of the day when he would no longer be "the man with the hoe." And to many farmers, the day of realization is already here.

The electric power line is reaching the most remote districts and with it a new science, a new system and a better, more prosperous life for those who produce life's necessities.

Thousands of acres of arid, unproductive land have been reclaimed and made to yield glorious harvests, through irrigation with electric motors and pumps. Tilling, planting, harvesting, threshing, ensilage, cutting and storing of grain may be done quickly with less work and greater profits for all concerned.

"Chores" which get the average farmer up early and keep him up late, may be motorized at little expense. Today, the water is pumped, the cows milked, the butter churned, the milk separated, the tools kept sharp—all by electrically driven appliances.

And the farmer's wife? With electricity as her housemaid, life is worth living. Cleaning, washing, cooking and sewing are done at the touch of a button. When evening comes there is the MAZDA Lamp and comfort, for electricity has done the day's work and will do tomorrow's.

To make the electrical machinery which generates and transmits this force, to study its application in the form of light, heat and power and to make it available for the betterment of all mankind, is the endeavor of the General Electric Company, exemplified in a service which has extended over a quarter of a century.

95-167

GENERAL ELECTRIC COMPANY

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

### Pertaining to Aeronautics

AIRCRAFT HAVING INHERENT STABILITY.—J. A. FLEMING, 10 W. 65th St., New York, N. Y. The primary object of the invention is to provide an aircraft having a novel arrangement of surfaces and structure, making it inherently safe. Another object is to obtain longitudinal and lateral stability and to prevent sideslipping. Another object is to obtain the maximum of lift, and a low forward center of gravity by disposing of the greatest weight to the forward end of the body of the aircraft.

### Electrical Devices

FLASH LIGHT TESTING APPARATUS.—G. A. LEY, 3912 No. Seeley Ave., Chicago, Ill. The invention relates to flashlight photography and the testing of apparatus for use in connection therewith. An object is to provide a lamp box and lamp for testing the electric circuit connection which is to be used in blowing a fuse and igniting the flash powder; the device may be used with a battery in which case a battery box is provided with the lamp box or with the ordinary city current.

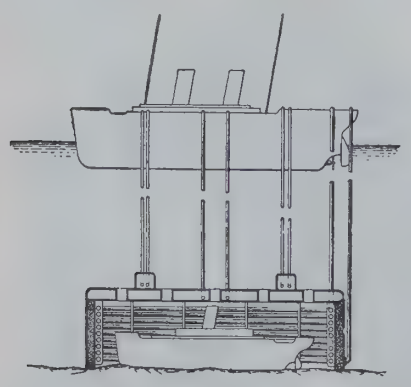
### Of Interest to Farmers

WAGON LOADER.—G. HAISS, 141st St. and Rider Ave., Bronx, N. Y. This invention has for an object to provide a device which is automatic in its operation. A further object is to provide a device in which the operation is continuous so long as there is any material to be operated upon. A further object is to provide a machine particularly adapted to operate upon piled material, and means for feeding the piled material laterally.

APPARATUS FOR HANDLING RACKS.—F. J. LOVERING, Octavia, Neb. This invention has for its object to provide a device especially adapted for placing and removing hay racks and wagon bodies from the running gears of wagons, wherein a wheel supported standard is provided, having means for lifting the rack or body one end at a time and placing it on the running gear, the wheels and the rack having means for preventing skidding movement during the lifting of the load.

### Of General Interest

APPARATUS FOR RAISING SHIPS.—W. F. GRUMME, 203 W. 103rd St., New York, N. Y. A hollow pontoon is provided by this invention which is adapted to be towed to and lowered over a sunken vessel. The pontoon is



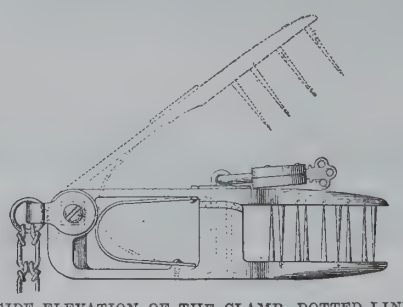
SHIP SALVAGING APPARATUS

provided with refrigerating means whereby the water enclosed within it may be frozen into a solid block of ice. When this is done the buoyancy of the ice brings the block, with the ship it contains, to the surface.

ROSETTE FOR BRIDLES AND OTHER PARTS OF HARNESS.—H. L. DAUGHERTY, Box 607, Carson City, Nevada. The object of the invention is to simplify and cheapen the construction of harness parts at the same time making them durable and attractive. The rosette comprises a hollow body having an inner flat wall provided with a transverse slot, and with a keeper adjacent the slot, a latch bar having a slidable connection with the keeper and having an angular portion adapted to enter the slot to engage the inner face of the flat wall and hold the latch bar in place.

SIGHT FOR FIREARMS.—J. E. KRAFT, Groveland, Cal. One of the principal objects of the invention is to provide a sight representing such a color to the marksman that it will contrast with the object aimed at. A further object is to provide a sight whose visual surface will be disposed at such an angle to the gun barrel that it will be always properly illuminated, irrespective of the angle at which the light falls on the sight.

ROBE SECURING DEVICE.—R. REID, 15 Jackson St., Sanford, Me. The invention pertains more particularly to robe clamps, and to devices of this character especially adapted



A SIDE ELEVATION OF THE CLAMP, DOTTED LINES SHOWING OPEN POSITION

for use in connection with vehicles. The primary object is to provide means by which a lap robe may be left in an automobile without danger of its being stolen therefrom.

CLASP.—L. B. HOCHSTEIN, 22 North St., Endicott, N. Y. The primary object is to provide a casp of the pivoted type especially adapted for retaining the open ends of a box or pasteboard carton in close relation. A further object is to provide a device which will be flat when in its operative position, and which may be entirely removed when in its inoperative position.

TOWEL CABINET.—E. J. SHAUGHNESSY, c/o F. O. Hendrick, 137 Greenwood Ave., E. Orange, N. J. An object of the invention is to provide a support for a continuous towel strip which facilitates the use of the strip. A further object is to provide a towel cabinet which will be economical in that the portions of the towel which are in use are maintained in a smooth condition, and the dirty or soiled portions are maintained out of contact with the clean, fresh portions thereof.

SETTLING TANK.—S. F. KELLER, Thebodaux, La. The invention has for its object to provide a tank of the continuous operating type for the clarification or separation of sugar cane juice or the like, after the juice has been treated with sulphur dioxide and neutralized with calcium hydrate, wherein the juice follows the natural trend of liquid that has been heated.

AMMONIA DISSOLVING COMPOSITION FOR USE IN REFRIGERATION APPARATUS.—C. DELAYGUE, Paris, France. An object of this invention is to provide a refrigerating composition which will dissolve large quantities of ammonia under high pressure with a resulting small volume. Another object is to provide a refrigerating composition which may be freed of ammonia by heating without giving off other volatile substances which would interfere with the refrigeration process. The composition consists of ammonium nitrate 3 grams, trimethylamin 2 grams, liquid ammonia 554 cubic centimeters, and sufficient water to make one liter.

### Hardware and Tools

LOCK.—L. E. CANTRELL, address L. M. Gibson, Maxwell House, Nashville, Tenn. The invention relates particularly to "pay-as-you-enter" locks which allow a person to enter a door on depositing the required coin. A money register is embodied within the lock to count the number of coins deposited and also the number of entrances through the door.

TOOL FOR REPLACING SUCKER RODS.—E. B. HATCH, Box 175, Turley, Okla. The invention relates to a tool for use in replacing sucker rods in oil wells. The object is to provide a tool by the use of which the dangerous operation of lifting the rods off of the elevator will be done away with, and which will make it impossible for rods to get away from the brakeman by proving a check for the rods in case the line should break, which will prevent the rods from falling farther than the tubing nipple.

### Heating and Lighting

COMBUSTION DEVICE.—S. YOUNG, Yquitos, Peru. The object of this invention is to provide mechanism of the character specified for permitting the utilization of fuel in the form of shavings, paper, straw, slack and the like, and for insuring the complete combustion of the same, and for conserving all the heat generated during combustion.

### Machines and Mechanical Devices

CRIMPING MACHINE.—E. T. REUTER and W. A. SKINNER, 366 Pearl St., Manchester, N. H. An object of ths invention is to provide mounting and operating mechanism for a pair of form plates instead of one which doubles the capacity of the machine over the Legge machine and which facilitates the employment of guards to protect the operator. With this device one of the plates is always descending so that double production is possible.

### Medical Devices

TRUSS.—G. H. EDDLEMAN, c/o J. Edington, Baltimore Bldg., Memphis, Tenn. The object of this invention is to provide an arrangement whereby the truss when once adjusted and placed in proper position may be permanently worn and all necessity for its removal, for instance in the bath, may be eliminated. A further object is to provide for various adjustments by which the pad may be properly and comfortably seated and thereafter locked in the desired position, permitting of free body movement.

### Musical Devices

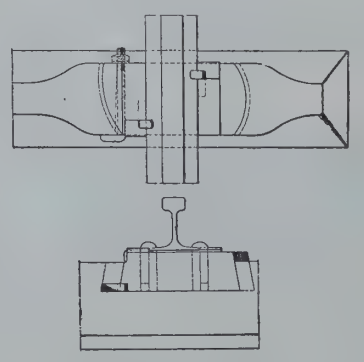
PHONOGRAPH NEEDLE.—J. HEINO, 1178 Washington Ave., New York, N. Y. This invention pertains to a phonograph needle which may be used any number of times, but in which the actual playing point is not of sufficient hardness to damage the record. A further object is the provision of a needle which shall incorporate means for holding the playing point so firmly that it is impossible that any slipping of the same might occur, but which nevertheless is capable of being instantly loosened and removed without the help of any mechanical skill.

### Prime Movers and Their Accessories

ROTARY ENGINE.—S. E. KOCHENDARFER, 58 N. Main St., Washington, Pa. This is an improvement on a prior application (Serial No. 164,436) which disclosed a rotary engine having L-shaped pistons. When the rotor was revolving fast there was a tendency for the piston to jump past the intake port and in certain positions to swing inwardly permitting escape of steam. These tendencies are overcome by an improved construction disclosed in the present patent.

### Railways and Their Accessories

CROSSTIE.—J. R. DOOLEY, 7 So. Springhill Ave., Mobile, Ala. The prime object of the invention is to provide a cross tie whereby rails may be supported and mounted thereon, and although the rail mounting may become defective on account of wear it will not be



A PLAN VIEW AND SIDE ELEVATION OF THE INVENTION

necessary to replace a cross tie, the construction being such as to enable the removable rail supporting section or block to be used, which may be removed from the cross tie and replaced in a practical manner. Another patent has been granted to the same inventor, the prime objects of which are to provide means for securing railway rails to the ties and for securing the meeting ends of the tie sections together.

LATERAL TAKE-UP DEVICE FOR LOCOMOTIVE AXLES.—H. B. FURSTONBURG, 1801 Park Ave., Shreveport, La. The present invention is an improvement on the inventor's previous patent (No. 1,202,701) which showed inner and outer take-up sections adjacent to each of the driving boxes, the inner sections being keyed to the axle and the two sections having abutting flanges. In the present invention collars are substituted for the inner sections and the flanges as well.

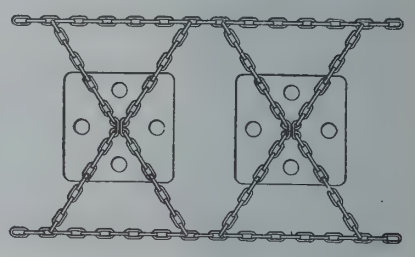
### Pertaining to Recreation

TOY AIRPLANE.—P. O. ROTH, 28 Pullis Ave., Middle Village, N. Y. A toy airplane of simple and comparatively cheap construction is provided by this invention. The toy is intended to fly a short distance through the air when thrown or projected by pressure from the rear. It is of strong construction and will maintain a substantially straight course on an even keel.

RACE GAME APPARATUS.—R. M. BRENNER, P. O. Box 151, Palisade, N. J. This is an improvement on the constructions described in patents No. 1,011,563 and No. 1,203,474, previously granted to Mr. Brenner. In the present invention each actuating device controlled by a player is rendered inoperative as soon as the racing figure reaches the goal. The construction insures winning of the race by the operator who exercises the most skill rather than speed.

### Pertaining to Vehicles

ANTI-SKID CHAIN.—E. BENJESTORF, Fenwood, Saskatchewan, Can. In connection with tire chains for the wheels of motor vehicles the inventor provides relatively flat plates



ANTI-SKID TREAD PLATE FOR TIRES

with lugs or projections which serve to prevent skidding of the vehicle. Owing to the fact that short lengths of chain pass between the lugs the possibility of clogging of the lugs with mud is removed.

ATTACHMENT FOR MOTOR VEHICLES.—D. L. STROUD, R.F.D. No. 2, Box 13, Mabel, Minn. The object of the invention is to provide an attachment adapted to support the rear wheels of a motor vehicle out of contact with the ground, to permit them to rotate freely to drive machinery of any character, and wherein means is provided on the attachment for permitting the rear end of the vehicle to be quickly and easily lifted on to the attachment to support the wheels for running freely.

HYDRAULIC JACK.—A. PAOLI, Hancock, Mich. The invention has for its object to provide a jack, small and compact of form, and especially adapted for use with motor vehicles, wherein a cylinder is provided having a base and a hollow piston movable in the cylinder and having movable therein another piston to which the saddle is connected, together with means for moving the hollow piston downward, to provide for a large amount of lift with small amount of controlling movement and without the use of valves or the like.

### Designs

DESIGN FOR A LAPEL RIBBON.—A. TILT, 51 E. 79th St., New York, N. Y.

DESIGN FOR A PIN, BADGE, FLAG OR SIMILAR ARTICLE.—C. A. HOWARD, 9 Maiden Lane, New York, N. Y.

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## Splitting Hairs With Close-Limit Tools

(*Continued from page 243*)

it is considered that 20 degrees Fahrenheit difference in temperature will change the length of an inch block by more than twice the margin to which the close grinding is held. The heat of the hands and the heat of the machines make so much difference that the work is checked on the indicator gages between successive grinding operations.

The final few molecules are caressed off the blocks by the die-making group, who get and assemble the parts. By a series of gentle rubbings against flat cast-iron blocks, they finally bring the various sections to so nearly the same size that it is necessary to split an inch into millionths to find out which is which. The slots in the blocks that hold the die sections, the punch sections and the shedder sections must be made to almost exact dimensions, and must have their sides absolutely parallel with each other, and absolutely perpendicular to the surface of the blocks.

Then there is the little question of "locating holes" and "locating pins," which must be accurate to about half a medium heavy shadow, and a lot of other close work that requires more patience than answering questions in an orphan asylum.

It is possible to work to even closer dimensions than the hundred-thousandth of an inch limit on the most particular class of tools, but it very rarely is done. For instance, there are two firms, one in this country, and one in Sweden, that make standard blocks of various lengths which they guarantee to be of exact size to within a few millionths of an inch. Either firm will, upon special order, furnish blocks within one millionth of an inch variation from true size. The check measurements on the blocks produced in this country are made by optical methods, using the wave length of light as the final measure, as has already been told in these columns.

## The Greatest of Floating Cranes

(*Continued from page 247*)

tional facts now before us it will readily be understood perhaps that the operation of transferring a big 250-ton gun mounting would run through substantially the following series of movements. The crane stands up about as erect as it can and swings around on its roller bearings until it has the gun mounting before it. The load is secured and lifted by operating the tackle connected with the rear hoisting blocks. There are two independent blocks, each capable of a lift of 125 tons. But there is a special block with which they may be interconnected, the whole combination being able to deal as a unit with the 250-ton load. The crane now rotates once more on its roller bearing until it faces the location where the mounting is to be deposited. It then extends its reach by flattening the angle of the jib. When the load is above its destination, the steel tackle is again operated and the mounting deposited.

The arm or "neck" with which the crane reaches outward and withdraws inward is the longer part of a single unit. The shorter part is another arm set at an angle of perhaps 135° with the longer part, the whole forming a bent boom. The whole is a rigid unit. It is pivoted at the bottom of the short part. It has but a single movement up and down in a vertical plane. The lifting and lowering of the load is or may be done ordinarily with one of the block-and-tackle devices without any movement of the bent boom. The boom itself is elevated and depressed with or without the load, the point at which it is stepped being the center of its radial movement in its vertical plane. This depression and elevation of the boom is accomplished by one of the most interesting features of the whole affair. Back of the boom is a triangular rocking beam. One vertex is hinged to a central framework at a level about half-way between the foot of the boom and its elbow. Another vertex is linked to the elbow, while the third—farther to the rear of the boom—is linked to the vertical cross-head of the elevating device. The cross-head shifts up and down in a vertical plane, these movements being accompanied by a lowering and elevating of the jib. Double plate girders provide for the guidance of the cross-head. The shifting of the cross-head between its guides is accomplished by two remarkable screws. These are each 60 feet in length and 13½ inches in diameter. By means of powerful machinery the great screws are simultaneously turned and the boom with whatever weight may be upon it raised or lowered.

*Crane Lighter No. 4* is so weighted by the disposition of its machinery, a certain amount of dead weight ballast, etc., that when there is no load on the crane and its boom has been elevated to the limit and has its minimum reach in an athwartships direction, the vessel heels over 4 degrees and has its deck depressed on the side back of the elbow. When the boom is depressed to the 100-foot radius for the inner blocks and a load of 250 tons is on the hook, the vessel heels the same amount but naturally in the opposite direction. No shifting ballast is employed. The crane has actually been tested with a load of 312 tons.

Hydraulic brakes are employed with some precision in controlling the movements when the great load is on. Steam brakes are also used.

The two floating cranes at Panama—the *Hercules* and the *Ajax*—are duplicates of each other. The pontoon measures, roughly, 150 feet in length and 89 in width. When the jib is withdrawn to its innermost position, its tip is about 206 feet above the deck. There is under the operator's cab a counterweight of 150 tons. A second counterweight three times as heavy is in the after part of the pontoon and a third on the cross-head. All movements are effected through electrical means.

## Malaria Control

MALARIAL control through the application of anti-mosquito agencies re-emphasizes the dictum that an ounce of effort at their breeding places is more effectual than gallons of immunizing fluids after the pesky insect has once obtained a lease on life. Recognizing the necessity of making warfare on polluted streams and other breeding sources of the mosquito, the U. S. Public Health Service has conducted a series of intensive experiments in an effort of controlling production of the germ-laden pest.

Among the unusual control methods adopted in the prevention of the hatching of mosquito larvæ is the spraying of streams with kerosene or a heavy black oil, classified by dealers as a grade immediately below fuel oil. The application is made with knapsack pump sprayers or by means of automatic drip cans. Of course, the expensiveness of the oil is a factor to reckon with, but one small Southern lumbering town made effective its control operations at an aggregate cost of $2,506.40, or a per capita cost of $1.23½. Moreover, the visits of the physicians for the purpose of treating malaria were reduced 70.39 per cent compared with the previous year. The permanency of control methods would undoubtedly curtail the operating expenses in making warfare on the mosquito.

The novel departure of applying the oil by means of a drip can be proved practical by the utilization of small platforms, stationed over the streams, from which cans were suspended. These stands were built of scrub-oak saplings or odds and ends of timber assembled from the lumber mills. Spaced 200 yards apart, the drip cups were so designed as to deliver drops of oil from an elevation

(*Continued on page 262*)

# Where Lincoln Cars are Leland-Built

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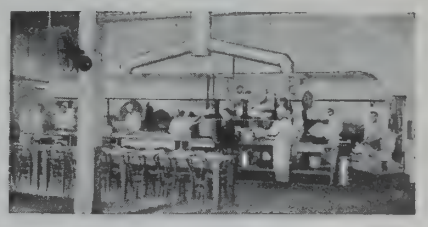

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### Malaria Control

(*Continued from page 260*)

of 4 feet to swiftly moving portions of the creek or stream. As the can absorbed the warmth of the day, it was so regulated as to permit of the delivery of 15 drops of oil a minute.

By the drip-can outlet, 1,035 gallons of oil were distributed on old ditches, 70 gallons applied to new ditches, and 258 gallons used in exterminating the mosquito larvæ along street ditches. The 50 drip cans used represented an expenditure of $39, while the cost of constructing the drip-can stands was calculated to be $9. There were two knap-sack sprayers purchased at an outlay of $14.79, and labor and spraying in the operation of control methods were estimated to be $238.69.

### Water Pipes of Wood

(*Continued from page 250*)

coating. Such a coating may be a paint or it may be a disinfectant. It is said that coatings are useful with fir and pine. With redwood the case is not so clear. A mixture of tar and asphaltum is considered excellent for the pine and fir; but redwood has done so well without the protection of a coating that the matter remains in doubt as to this material.

Wood stave pipe is held together by steel bands or hoops placed at frequent intervals. There are two problems here. One concerns itself with the strength of band required to resist the bursting pressure of the contained water. This will naturally vary with the head and with the size of the intervals between bands. The second problem centers on the tendency of the tightened band to sink into the wood. The size of the band, the spacing interval and the bursting pressure—all play their part here. For almost any given pipe line there will be two or three sizes of band permissible, but the spacing for the different sizes will naturally vary also. A representative band is a round rod with a button at one end and, say, 5 inches of thread at the other. A fitting, called a *shoe*, is employed to cinch the ends of a band together. These vary somewhat in design. It is considered important that the shoe should be stronger in the body than the band itself, as thus it is possible to develop the full strength of the rod. A case has occurred, it seems, where the shoe was weaker than the band, and in consequence somewhere about 390 tons of steel were wasted.

The staves make butt joints with the stave ahead and the one to the rear. Naturally, these butt joints are distributed so as not to have an undue number at any one point of cross-section. In order to prevent leakage at these joints, the following precaution is taken. A steel or iron strip, perhaps ⅛ inch thick, called a *tongue*, is arranged to lie half in one stave end and half in the other. Slots are provided to receive the tongue. The width of the tongue will be, say, 1½ inches. Its length is a little greater than the width of the staves at the locations of the slots. This extra length permits insertion of the tongue ends in the side edges of the adjacent staves. They are coated over with an asphalt base paint.

It is said that, in the case of redwood pipe, the life of the bands determines the life of the pipe. It is accordingly important to prolong the life of these hoops and their shoes, and therefore to use the proper coating at the outset. A paint with an asphaltum base is considered a proper one. Now and then a band will have to be replaced; but generally speaking its life is understood to be greater than that of steel pipe. A reason for this has been given. The band, being round, exposes an inconsiderable surface to the weather. Red lead is considered a very good coating material, indeed. Galvanizing is a method of protection that is costly; but it appears to be the only thing employed in the Hawaiian Islands in connection with redwood.

Instead of the continuous wood stave

(*Continued on page 264*)


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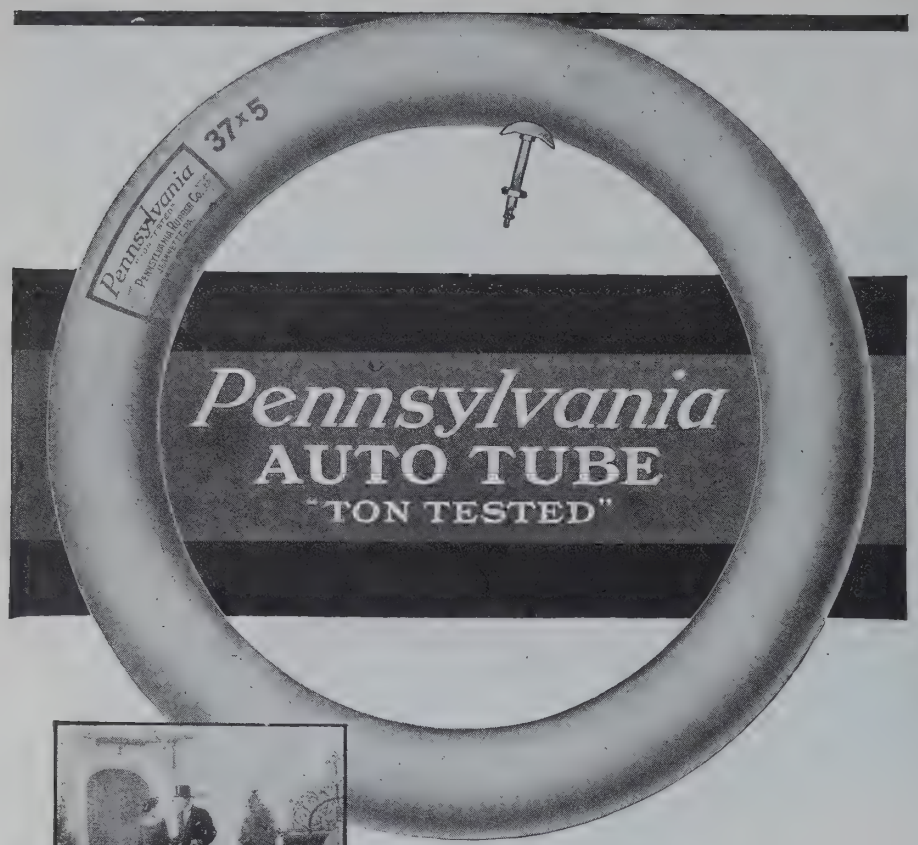

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## Water Pipes of Wood

(*Continued from page 262*)

pipe, the whole of whose erection is carried out in the field, one may substitute short lengths of machine-made wood stave pipe. That is, machine-banded or wire-wound pipe may be employed. Such piping may be obtained in diameters ranging up to 24 inches, inside diameter. The lengths run from 8 to 24 feet, and are provided with the collars and couplings necessary to their secure junction in the field. Such pipe is understood to be made for heads running up to 400 feet. The band, or wire, is secured to the pipe by means of pressed-steel clips or staples or both. The sections, once banded, are dipped in melted asphalt and then rolled in sawdust. The asphalt affords protection, the sawdust makes it possible to handle the pipe.

Some of the more important installations of continuous wood stave pipe are the following: At Atlantic City, N. J., a 48-inch line, 5 miles long has been laid across the salt marshes where metal pipe lines have failed. A big piece of wood piping is the line laid for the Erie Construction Co. (a subsidiary of the Ontario Power Co. of Niagara Falls). The whole line is about 1½ miles long. The shorter half consists of 144-inch pipe and the longer half of 132-inch. Pretty big tubing. The maximum head in contemplation was 150 feet. But there is a mile of continuous wood stave pipe which forms part of a big hydroelectric development on the White Salmon River and which has the magnificent diameter of 162 inches. Some pipe! It is carried on wooden cradles 4½ feet apart, center to center. The weight of the contained water is nearly 900 pounds per linear foot of pipe.

## Checking Up the Gas Meter

(*Continued from page 252*)

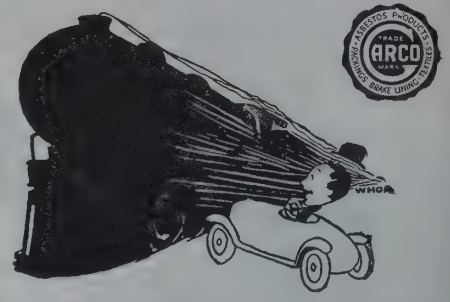
the building. On large yellow oblong sheets of paper the meter's "pedigree" is entered—the size, the manufacturer, the premises it came from with the date, the number of years it was in service, the number of previous tests, and the date of each test. Beside the spaces for these entries there is a column in which is printed a series of indices similar to the clock faces of a meter, and hands are drawn on the diagrams to correspond to these on the meter under observation.

In the initial testing operation the meter, attached to the prover, is under conditions exactly the same as when in the home. In this first operation the "U" shaped water gage shows whether any gas is escaping from the meter box. Care must be exercised in attaching the hose. Sometimes three minutes are necessary to adjust it to the satisfaction of the tester.

After this preliminary test the meters are opened to see how much repairing is needed. Their condition determines whether they fall into the classification of light, medium, or full repairs. On the tenth floor a force of men puts in the parts which the previous inspection showed were needed. Upon the completion of repairs and a test of the meter for soundness, a high pressure test is made.

Sometimes a leak is not detected by the "U" gage. When this happens the meter case is filled with water. No matter how small the hole, it is soon discovered. After soldering, another test is made for soundness. Ordinary meters have 50,000 cubic feet of air passed through them to detect any defects, like a loose cog or a buckle at any point. In the operation several meters are linked up together, with a connection to a master meter. After this test there is a final one made with the provers before the meters are sent to what is called in the building the State Department—a space on the ninth floor, on the east side of the premises, where inspectors of the Public Service Commission are at work.

(*Continued on page 266*)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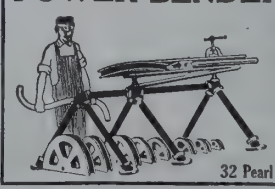
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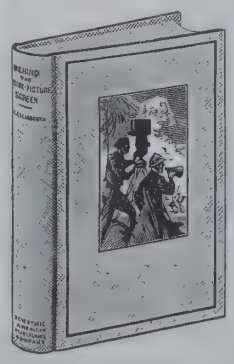

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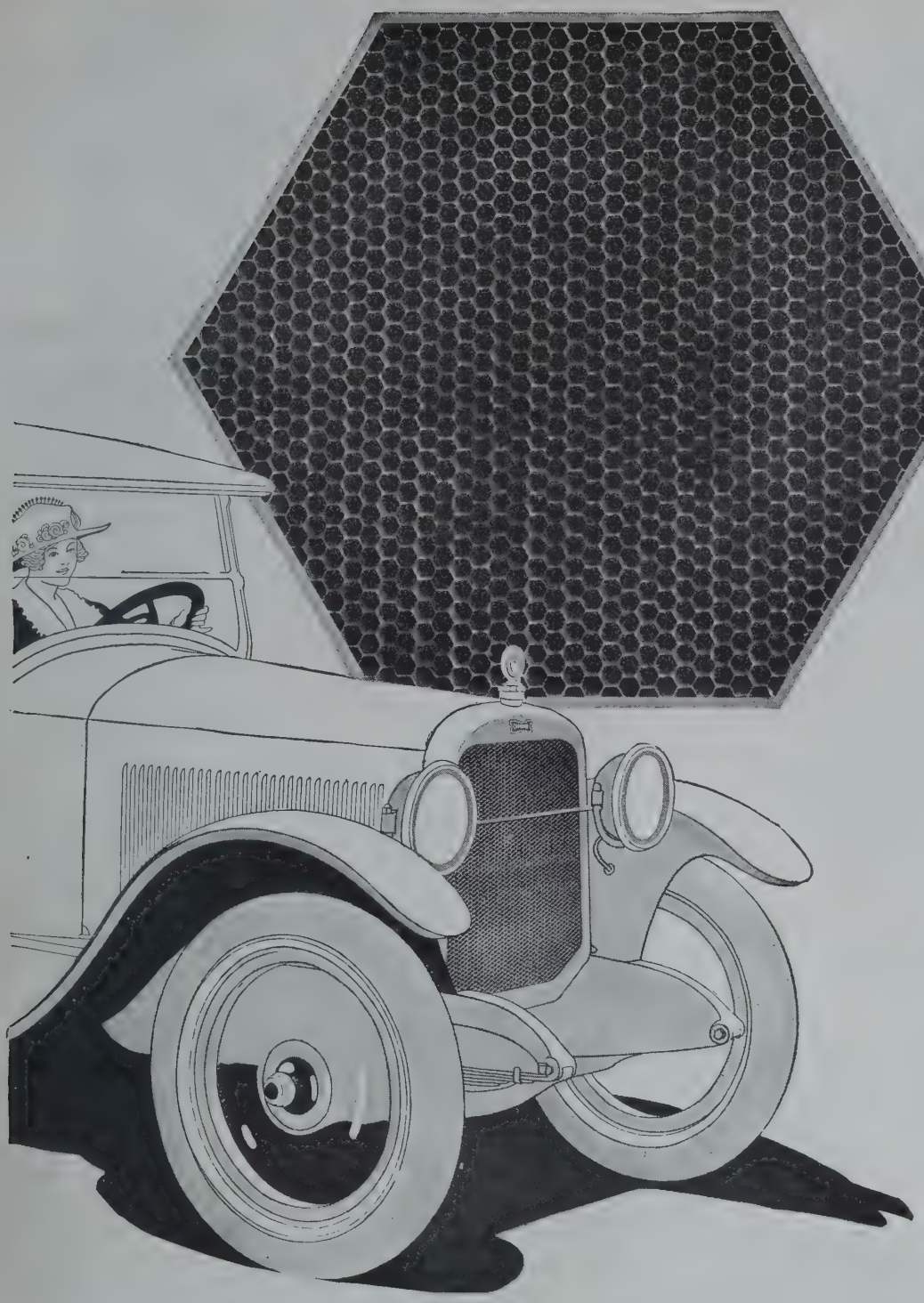

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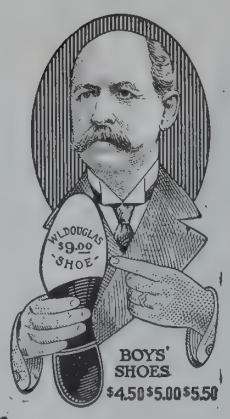


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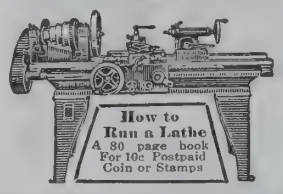


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## Checking Up the Gas Meter

(*Continued from page 264*)

Here there are twelve proving machines identical in design with the ones used by the company. The inspectors, after verifying the company's tests, apply the seal of the commission at the top of each meter, near the upper edge of the index. So strict are the regulations as to the use of the seal that inspectors are under instructions to carry their sealing irons home with them at the end of the day's work.

On this floor the meters are painted and placed in bays, according to the ownership of the various gas companies throughout the city. On this same floor the prepayment or slot meters are tested.

An important part of the testing operations is the examination of the diaphragms. These are made of Australian sheep leather—found by experience to be the best material for this purpose—and are attached to the metal disks in the measuring chambers. Generally speaking, the disks and diaphragms constitute a kind of double bellows. The quantity of gas used is measured by the number of times they fill and empty—consequently they must not leak in the slightest degree.

Quality of leather and the exercise of all possible care in the manufacture of the diaphragms cannot prevent mishaps to them now and then. In severe weather a meter will sometimes freeze, which destroys the leather. It turns white and gets hard. All diaphragms are examined by an expert with a view to learning the extent of the repairs that might be necessary. In the majority of cases the leather only needs softening. This is accomplished by giving it a bath in Pennsylvania mineral oil heated to a temperature of 110 degrees Fahrenheit.

All new meters are tested for accuracy on the ninth floor. Great care is exercised in the adjustment of the tangent in the valve chamber. The tangent bears the same relation to the testing mechanism as a pendulum to a clock. Hence it must be adjusted to a nicety, if the meter is to meet the requirements set by the Public Service Commission, which, it may be added, guarantees the reliability of all meters upon which is has placed its seal after a test for accuracy.

## America's Bid for the Gordon Bennett Cup

(*Continued from page 253*)

thus lessening wind resistance, they have added 25 miles an hour to 125 miles an hour speed of the monoplane, and from 30 to 35 miles an hour while it is racing at 175 miles an hour or more with flattened wings.

The body of this very remarkable plane is of monocoque construction. In other words, it is made of thin strips of wood bound tightly with fabric strips laid in glue, the strips criss-crossing the under layer each time that a layer of wood is applied. The pilot sits inside the machine completely enclosed by the doors which open on either side just back of the point where the wings cross the top of the body as though laid over it.

The machine is powered with a special Hall-Scott racing engine of the Liberty Six 250-horse-power type, made by the Hall-Scott Motor Car Company of Berkeley, Cal. Although the Dayton-Wright monoplane will probably be the lightest powered entry in the Gordon Bennett race, its designers hope that the relative power and speed achieved will enable it to outfly heavier competitors. The efficiency of the motor is to be further increased by using a special synthentic fuel developed in the Dayton-Wright laboratories.

This unique monoplane will be flown in the races by Howard M. Rinehart, who with Milton C. Baumann, designed it. The plane is known as the "R-B," derived from Rinehart-Baumann.


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## A Queer Visitor in the Garden

(*Continued from page 255*)

the dandelions; when he reaches the vegetable garden even the rhubarb leaves disappear; and when he lands among the flowers he is equally impartial.

Yet though he is a gormand he is not nearly so destructive as the legions of his tiny brothers, the garden slugs. Ariolimax is big and easily found, easily kept away. Lime or salt is fatal to him. When he encounters either he perishes miserably, the salt especially making a dreadful mess of him: he disintegrates. A sprinkling of dry lime around a flower or vegetable bed usually will protect it except in wet weather. Even dry sand makes a fairly effective barrier, difficult for the invader to cross.

Though not much of the life history of this creature is shown in the garden, something additional is disclosed in the woods. The young are met early in the spring and doubtless the eggs are laid by the adult among the leaves and protective debris of the forest floor. When first hatched the young are like the parent but very small; but they grow rapidly and by the end of May they are about an inch in length. They are colored like the adults but are shorter and thicker in proportion to their length. Their mission in life seems to be merely to eat and grow, and they do both tremendously, arriving shortly at the size of their leviathan parent; and when the rains of autumn trickle through the firs they are ready for a six-foot-an-hour pilgrimage into the garden.

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BATTLEFIELDS OF THE MARNE. 1914. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 292 pp.; illustrated; maps and plans.

Combining a history and a tourists' guide, this handbook transforms a tour into a pilgrimage, and makes the very ruins tell their absorbing stories. The fine finish of paper used brings out well the strikingly artistic effect of the hundreds of illustrations. Following practical information that will greatly further the convenience and comfort of the traveler, a tour is outlined for the Ourcq, the marshes of Saint-Gond, and the pass of Revigny. The plans and maps are skilfully drawn and colored.

THE STANDARD ELECTRICAL DICTIONARY. By T. O'Conor Sloane, A.M., E.M., Ph.D. Addition by A. E. Watson. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 767 pp.; illustrated.

In its 1920 edition, this well-known reference work carries a substantial supplement containing the very latest developments of electrical science. There are 6,000 terms briefly defined; but the definition is immediately followed by a popularly-worded explanation that may run to several hundred words. These little articles are further amplified by hundreds of cuts and diagrams, the whole constituting an encyclopedic exposition of modern theory, experimentation and engineering.

YPRES AND THE BATTLES OF YPRES. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 139 pp.; illustrated; maps and plans.

Ypres, dominated by low hills, was the theater for some hot work during the war. Succeeding situations are here diagrammatically outlined for us. We find a clear account of the first and second battles, the allied offensive of 1917 in its six phases, and the German attacks of 1918. The material, richly illustrated, is so arranged as to make easy a two-day visit to the town and the salient, and covers all features of interest.

VERDUN AND THE BATTLES FOR ITS POSSESSION. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 112 pp.; illustrated; maps and plans.

Verdun took some of the mightiest hammerstrokes of the German army. The battles for its possession may be understandingly followed by means of the plans of the great offensives given in this guide. Our own soldiers helped to clear Verdun, and a noteworthy picture is the panoramic view of the battlefield as seen from a German observation post. There is a good plan of the city, many scenes from its streets, and folding maps that show fine detail.

RHEIMS AND THE BATTLES FOR ITS POSSESSION. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 176 pp.; illustrated; maps and plans.

The bombardment of Rheims and the wanton wrecking of its imposing cathedral form one of the most unforgetable chapters of the war. After seeing the plans and pictures of this excellent guide, we seem to have been actually over the ground. Both the student of the war and the tourist will find this a work well worth possessing.

LILLE BEFORE AND DURING THE WAR. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 64 pp.; illustrated; maps and plans.

Lille, another old historic town, has a page devoted to its history. How it fell in 1914 and how it was delivered after a four years' occupation is told in maps and text. The town is covered in four itineraries with very exact directions to the tourist, aided by plans and embellished by pictures of buildings, monuments, and works of art.

SOISSONS BEFORE AND DURING THE WAR. Milltown, N. J.: Michelin Tire Co., 1920. 8vo.; 64 pp.; illustrated; maps and plans.

This guide follows the same admirable arrangement of others in the series, giving first the chief historical events and a descriptive summary, followed by the incidents of the German occupations and evacuations and the life of the place during the thirty months' siege. The traveler is conducted to and through the cathedral, through the badly-damaged quarters of the town, by ruined churches, and finally to the surrounding scenes of desolation left in the wake of battle.

AMERICAN GUIDE BOOK TO FRANCE AND ITS BATTLEFIELDS. By E. B. Garey, U.S.A., O. O. Ellis, U.S.A., and R. V. D. Magoffin, Ph.D. New York: The Macmillan Company, 1920. 8vo.; 331 pp.; illustrated; maps.

As Major General Leonard Wood says in his foreword, "The names of the authors guarantee not only its practical value as a traveler's guide, but its dependability in matters of civil and military history." The book avoids the interminable detail of the ordinary guide, for various and good reasons; but it answers most questions on the mechanics of travel, sketches the terrain of the war with especial reference to American participation, and furnishes facts and figures in common demand. Our soldiers and their friends will find the account of operations and the Division Histories of the greatest interest. The pictures and folding maps deserve a specific word of praise.

THE DESIGN OF ALTERNATING CURRENT MACHINERY. By James R. Barr, A.M. I.E.E. and R. D. Archibald, B.Sc. New York: Isaac Pitman and Sons. 8vo.; 496 pp.; 340 illustrations; 17 folding plates.

This substantial work, a companion volume to Barr's "Direct Current Electrical Engineering," first considers complex wave forms and harmonic analysis; transformers, alternators and converters receive a very full treatment; mechanical features, insulation, efficiencies, tests and losses are dealt with from a practical point of view and, in addition to ample illustration throughout the text, there are sixteen folding plates that ably reveal the construction of the various devices.

AUTOMOBILE BATTERY CARE AND REPAIR. By Harold P. Manly. Chicago: Frederick J. Drake and Company, 1920. 16mo.; 335 pp.; illustrated.

Wherever starting, lighting and ignition repairs are made or storage batteries handled, whether in the shop or the public or private garage, this compact handbook will prove its worth. It is a manual for the workman whose aim is to turn out satisfactory work without lost motion or wasted time: it makes him intimately acquainted with the lead-acid battery and operating conditions, with charging equipment, and with the best method of test and repair.

FORESTS, WOODS AND TREES IN RELATION TO HYGIENE. By Augustine Henry, M.A., F.L.S., M.R.I.A. New York: E. P. Dutton and Company. 8vo.; 314 pp.; illustrated.

The economist, engineer and physician, to say nothing of the general reader, are insufficiently informed regarding the influence of trees on climate, water flow, soil erosion, and the purity of air and water. While this work is specifically concerned with reforestation in Great Britain, the information and general principles are largely applicable to our own needs, and should benefit American readers. Among other branches of the subject it takes up sanatoria sites, town parks, and conditions affecting the planting of water catchment areas.

IN THIS ISSUE:

SHALL THE CORN FIELDS RUN OUR CARS?
NEW CONCEPTS OF THE PAST CENTURY

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

INSPECTING 140 SEPARATE POINTS OF AN AUTOMOBILE ENGINE CAM SHAFT—[See page 278]

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20 cents in Canada

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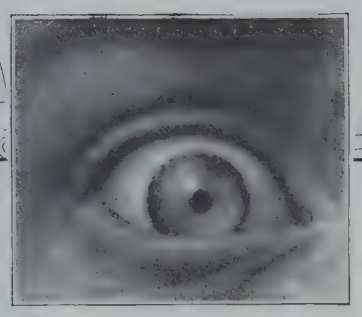

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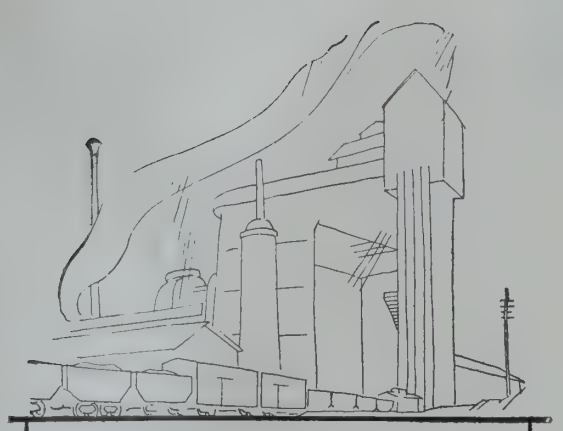

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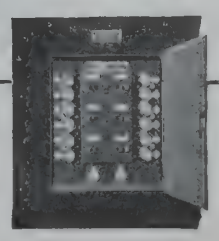

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SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 12

NEW YORK, SEPTEMBER 18, 1920

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## A Mammoth Steam Unit and Its Work

By Sydney G. Koon, M. M. E.

RECENT reports of a remarkable run made by a forty-five-thousand-kilowatt steam turbine in a Providence, Rhode Island, lighting plant have shown figures believed to be a world record for continuous service for a unit of this size. The run covered 84 days, 11 hours, 36 minutes, or a total of 2027.6 hours. During this period the machine turned out 50,791,000 kilowatt-hours, or an average of 25,050 kilowatts over the entire period. This was just 55.7 per cent of its rating.

Attention has been drawn to the great economy of this turbine, the result having been obtained from about 1.4 pounds of coal per kilowatt hour. It is believed that the average coal consumption in central stations of the United States, per unit of power delivered, is fully double this figure. Consequently this machine is working valiantly in an effort to cut down the high cost of living.

Some of the results of this run, when compared with familiar items, make rather startling reading. The total coal burned during the run was about 71,000,000 pounds, or 35,500 net tons. At the usual bulk of 43 cubic feet per ton, this gives 1,526,500 cubic feet, or a pile of coal 305 feet long, 100 feet wide and averaging 50 feet high. To carry this coal, twenty trains of forty-five cars each would be required, each car carrying forty tons. To carry it by water would require five colliers, each of 7,100 tons cargo capacity. The United States Navy includes five coal-carrying vessels of about this unit capacity, which cost for construction an aggregate of $4,694,297.

The total steam consumption of the turbine is said to have been 609 million pounds. This represents the evaporation of 9,760,000 cubic feet of water, assuming that there was no water lost. The steam used, if at 200 pounds pressure, would have a total volume of 1,303,000,000 cubic feet, which is the equivalent of 87 Woolworth buildings. At atmospheric pressure it would form a continuous cloud of the width and height of the Woolworth building and 41 miles long.

The amount of water which was evaporated into steam was sufficient to give every one of the 1,750,000,000 inhabitants of the world a drink of water, each glass containing five and one-half ounces (one-third of a pint). This bulk of water would fill to an average depth of 6 feet 2 inches a swimming pool 30 feet wide and ten miles long, stretching from the Battery to two miles above Grant's Tomb, in New York City.

## Aluminum Dust Explosions

WE have had ample opportunity to know that organic dusts when suspended in air are highly explosive and the effects of explosion of gun powder, gun cotton, and the like, are understood for they depend upon the production of large volumes of hot gas of high critical point. This familiar explanation does not hold in many other instances. The Bureau of Mines, for example, in Technical Paper No. 152, presents data with regard to an explosion of aluminum dust, which material is largely used in the manufacture of metallic paint. Aluminum in this highly divided form burns quietly when a small quantity is ignited, but if the dust is distributed through a confined air space the combustion is violent in character. When so mixed with air, aluminum powder may be ignited by an electric spark and this has doubtless caused some of the explosions. When water is thrown on burning aluminum, hydrogen gas is evolved.

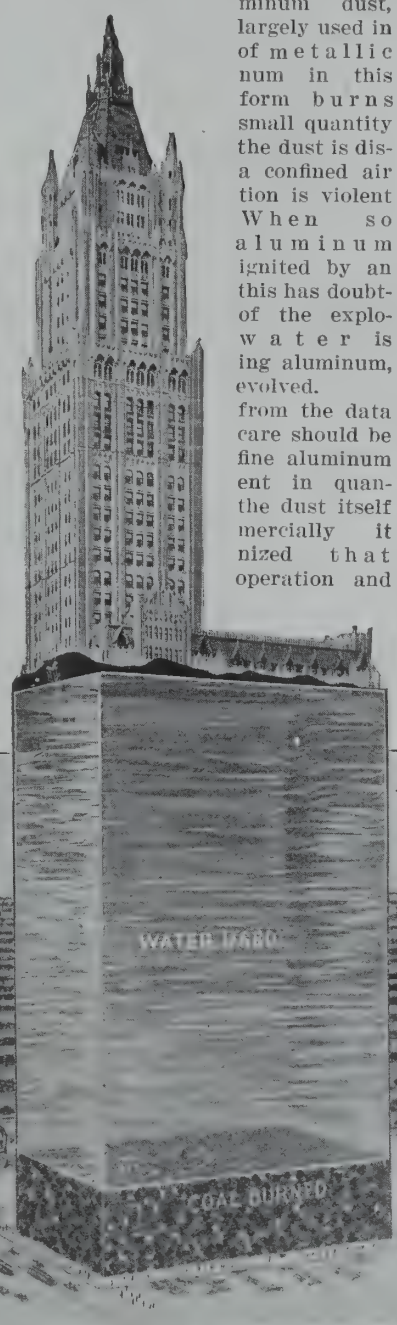
It is evident from the data presented that care should be exercised where fine aluminum particles are prescribed in quantity, and where the dust itself is prepared commercially it must be recognized that risks attend the operation and safeguards to insure proper handling should be planned accordingly.

## Photographic Developers

IT was to be expected that foreign manufacturers would endeavor to regain the American market and there have been numerous instances of advertising and other propaganda maintained for the purpose of retaining good will. In the January number of *Photographische Korrespondenz* of Vienna there is a note which refers to the progress made in America, although evidently the writer of the paragraph obtained his information from but one of our photographic periodicals since there are other manufacturers of these developers not mentioned. The article says that: "The cessation caused by the war of the exportation of photographic developers, of which Germany was the principal source of supply, caused foreigners to undertake the preparation of such substances in which attempts the German patent served as the starting point or was entirely used in the manufacture. The following developing substances similar to metol are found in the American market; monomet, serchol, phenomet, metoltoch, rhodol (monomethyl paramido-phenolsulfate), scalol, amidol, rexolon." Various claims of equality or superiority to the old German production which might be found in the advertisements of these materials are quoted in the aritcle, which concludes with a reference to the desirability of the old German metol, notwithstanding the large number of competitors which the war has introduced.

## Water-Proofing

IN a series of tests designed to improve the waterproofing of materials such as propellers for airplanes, the Forest Products Laboratory has demonstrated that when aluminum leaf can be used with a lacquer or varnish which cements it to the wood, the resulting coating is twenty-five times more effective than any other process for water-proofing wood. The leaf can be applied quickly and the cost is not prohibitive. The necessity for water-proofing a propeller is illustrated by the fact that at times eighty per cent of the propellers produced in France were rejected by the pilots, because of a lack of balance, much of which could be traced to unequal absorption of moisture. Of course, the same method of water-proofing is applicable to other appliances.




The coal burned would fill 50 feet of the Woolworth Building; the water used would fill the rest of the main structure to within a few feet of the tower's base. The coal would require twenty trains of forty-five cars each for its transport, and the steam generated, at working pressure, would fill 87 Woolworth Buildings, as indicated by the comparison of bulk at the lower left.

What the 84-day run of the big turbine means in terms of coal and water

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## The Einstein Judges

AFTER a rather longer interval than we had anticipated, we are now able to announce the identity of the Einstein Judges. The decision as to the size of this committee we have made after careful consideration; and while we believe it to be a wise one, we realize that in some respects it may be a surprising one, and that the grounds on which it is based ought to be stated.

We are assured with complete certainty that the competition for the five-thousand-dollar-prize will be very keen, and that many essays will be submitted which, if they bore the names of their authors, would pass anywhere as authoritative statements. The judges will confront a task of extraordinary difficulty in the effort to determine which of these efforts is the best: and we believe the difficulties are such that multiplication of judges would merely multiply the obstacles to an agreement. It is altogether likely that the initial impressions of two or three or five judges would incline toward two or three or five essays, and that any final decision would be attainable only after much consultation and discussion. It seems to us that by making the committee as small as possible while still preserving the necessary feature that its decision represent a consensus, we shall simplify both the mental and the physical problem of coming to an agreement. We believe that the award should if possible represent a unanimous decision, without any minority report, and that such a requirement is far more likely to be met among two men than among three or five. At the same time, the bringing together of two men and the details of general administration of their work together are far simpler than if there were three or five. So we have finally decided to have but two judges, and in this we have the endorsement of all the competent opinion that we have consulted.

At the same time, a strict interpretation of the postal laws forbids that we introduce into the contest, by any suggestion of dividing the prize, what the Post Office looks upon as an "element of chance." It is therefore necessary to make provision against the remote contingency that the judges be really unable to reach an agreement. In this event, our own Einstein Prize Essay Editor will cast the deciding vote, between the two essays favored by the individual judges. Aside from this, of course, the SCIENTIFIC AMERICAN will have no voice in the award.

The gentlemen who have consented to act as judges are Professors Leigh Page and Edwin Plimpton Adams, of the departments of physics of Yale and Princeton Universities, respectively. Both are of the younger generation of physicists that has paid special attention to those phases of mathematics and physics involved in the Einstein theories, both have paid special attention to these theories themselves. We are gratified to be able to put forward as judges two men so eminently qualified to act. We feel that we may here appropriately quote Professor Page, who says in his acceptance: "As the large prize offers a great inducement, I had thought of entering the contest. However I realize that not many people in this country have made a considerable study of Einstein's theory, and if all who have should enter the contest, it would be difficult to secure suitable judges." Without any desire to put the gentleman in the position of pleading for himself, we think this suggests very well the extent to which the SCIENTIFIC AMERICAN, the contestants, and the public at large, are indebted to Professors Page and Adams for their willingness to serve in the difficult capacity of judges.

## Aerial Stunts and Public Safety

IT was inevitable that, in his quest of the novel and sensational, the photographer would, sooner or later, enlist the services of the airplane; and it was probable that, in his effort to secure pictures of a sensational character, he would ultimately expose both the pilot and the public to very serious risks. Evidence of this was seen during the recent contests for the America's Cup off Sandy Hook, when the airplanes repeatedly flew at dangerously low altitudes over the fleet of yachts and excursion boats that were crowded around the starting line, some of them threading their way through the fleet at an elevation of only a few feet above the water.

It is well understood that if a skilful pilot is flying at considerable height, he can pull his machine out of a dangerous situation such as a side slip, a nose spin, or a tail spin; whereas, at a low altitude a crash is inevitable. The peril of taking aerial photographs of sporting events lies in the temptation to descend to low altitudes and slow down the flying speed—a dangerous combination should anything go wrong with pilot or motor. As it was, there were several forced descents during the Cup races and it was more "by luck than good shooting" that no fatalities occurred.

It was reserved for the attempt to photograph the final match for the Tennis Championship at Forest Hills to demonstrate, in tragic fashion, the peril of close-up aerial photography. Two veteran airmen of the war, a pilot and a photographer, while circling outside the courts on which Tilden and Johnston were playing the final, suddenly went into a nose-spin and crashed a few hundred feet from the crowded grandstands. There is no doubt in the mind of the writer, who witnessed the fall, that these experienced men were the victims of their zeal to secure good close-up photographs—their maneuvers after they reached the grounds from Mitchel Feild and the behavior of the machine at the turns and in the fatal plunge confirm this opinion.

When the machine first reached the vicinity of the courts it was at a height of apparently twelve to fifteen hundred feet. After circling the field, it came down to about nine hundred and finally to about five hundred feet. The pilot then throttled down to a speed that was slow even for a Curtiss JN-4. At this low elevation and slow speed the pilot closed in on the field, circling a few hundred feet outside of the court and grandstands. He never passed over the field at this elevation, the press statements to the contrary notwithstanding.

The flight of the machine when throttled down was noticeably unsteady, and the banking at the turns seemed to be excessive for the speed. Finally, off the northwest corner of the court, a sharp turn to the left was made, with an exceptionally high bank. The machine appeared to side slip, then dived steeply and immediately went into a nose-spin, and so low was the elevation that there was no possibility of recovery. Both men were killed.

The moral of this distressing accident, which has robbed the country of two experienced airmen, is that the taking of close-up aerial photographs of sporting events at which large crowds of people are assembled should be absolutely prohibited. Had the machine gone out of control a few hundred feet nearer the courts, it might well have fallen among the eight or ten thousand people on the stands, in which event a score or more of lives might have been lost and twice that number of people injured.

Furthermore these aerial pictures of sporting events are not worth the danger incurred. At the best they fail to show any illuminating detail of the play, and for practical purposes they are greatly inferior to the superb pictures which can be secured from the ground or from the top of neighboring structures. The Army and Navy officials should put a ban upon photographic stunts of this kind and the State and Municipal authorities should follow suit.

## The Importance of Negative Results

ONE aspect of recent scientific developments which does not appear to have received its deserved attention, is the pointed lesson we have received regarding the importance of negative results in experimental investigations. It would be useless to deny the fact that the worker in science welcomes more heartily positive findings than the establishment of a negative conclusion. Science may be impersonal, abstract; but the scientific investigator is perforce concrete, human. He may set before him as an ideal an absolute impartiality, a complete freedom from bias, from desire to find anything but the truth, whether palatable or not. But ideals aside, he cannot help being in some degree influenced by a variety of factors, with the general result that he will on the whole give preference, in his selection of a task, to problems likely to lead to positive results.

It is therefore well that we should be reminded, from time to time, that negative results are always important, and, in certain instances, have proved of the very highest order of importance. Thus the foundation of the edifice reared by Einstein is the Michelson-Morley experiment, a classical piece of work conducted with consummate skill and care; the very fact that its results were negative necessitated the most extreme precautions, and none but expert experimenters would have been qualified to give us a report with the degree of reliability demanded in just such cases, where the effect looked for is either small or null.

It is interesting in this connection to note some of the other classical examples of negative results in experiments of superlative importance. There is, first of all, the accumulated evidence of numerous attempts to build a perpetual motion machine, resulting invariably in failure. It may be urged that these chimerical attempts were of necessity foredoomed to failure in view of the law of conservation of energy. But we may equally well say that the evidence of these consistent failures is one of the data on which we base our conviction in the law of conservation of energy. Similarly, the common experience that it is impossible to run an engine by the aid of the heat contained in a cold body (for example, to run an ocean liner by heat drawn from the sea) may be regarded as the basis of the so-called second law, the law which indicates the upper limit of efficiency attainable in a heat engine.

The mathematician too has a little group of negative results of his own that are of more than passing interest. For a great many centuries he tried to solve the classical problems of duplicating the cube, trisecting the angle, and squaring the circle; until his repeated failures led him to the conviction that the problems were not to be solved within the terms proposed. But he did not stop here; he has carried his investigations to the point where he can prove the impossibility of doing any of these things within the terms proposed, and can now say, not merely that failure to do them indicates their impossibility, but that they are impossible and he knows why. This categorical establishment of a negative result is something seldom met in other fields than the mathematical, and in fact enables the mathematician to escape much of the implicit sting of the failure to achieve something positive.

Some years ago we would have added to the list of classical negative results the attempts at transmuting elements. Today we have stricken out this item and placed it among the array of the accomplished facts of science, though to be sure the transmutation realized is not that active operation dreamed of by the alchemists, but a passive process over which we seem to have little or no control.

Lastly, of famous negative results, must be mentioned our failure to produce life by spontaneous generation. We are so accustomed, today, to the idea that life springs from life alone, that we hardly realize how to an earlier generation there seemed nothing in any way fanciful or improbable in the supposition that maggots, for example, originated, directly and without intervention of parents, from decaying refuse.

## Engineering

**Canada's New Highways.**—Five million dollars will be spent this year in making better main highways of Canada through Federal and provincial grants. Of this amount the Dominion Government will contribute $2,000,000 and the provincial governments $3,000,000. This is the first year in which the road money has been available, and in view of the time taken in preparing plans the initial year's outlays will not be so heavy as in some succeeding years.

**Ashes as Road Material.**—The city of LaCrosse, Wisconsin, is to continue the plan adopted about two years ago of covering the city streets with ashes. By this plan the sandy and almost impassable streets are converted into smooth, hard driveways. In the last two years the Board of Public Works has thus improved about ten miles of streets, using the ashes from residences and factories. Between 30 and 35 loads of ashes (two yards per load) are required for the improvement of one block of sandy street, at a cost of a little over $14 per block for haulage only, or about $186 per mile, as against the old practice of paying to have them hauled and dumped on waste land.

**Pressure of Concrete on Forms.** — A pressure-gage devised by A. T. Goldbeck and used for the last few years in measuring earth pressures behind retaining walls and under fills, has been applied successfully to the measurement of the pressure of concrete on forms embedded therein. The gage consists essentially of an air-tight metal cell having a circular weighing face 10 sq. inches in area, according to the *Engineering News-Record*. The concrete pressure against the face of the cell is balanced by admitting compressed air to the inside of the cell. When the pressures are balanced an electrical contact is broken which extinguishes a light and signifies that the pressure shown on the gage connected with the air pipes is equal to the pressure of the concrete.

**Hydraulic-Fill Dams.** — The hydraulic method of dam construction has great advantages, but many dams built by it have failed. As often built the center of the dam is composed of a clay core completely water-tight but very wet as a result of the method of construction, and so completely water-tight that it is incapable of permitting its own drainage. This soft core exerts the pressure of a liquid of high specific gravity upon the toes, and tends to push them out. Most of the failures of this type appear to have been attributable to this pressure, continues Allen Hazen, in the *Proceedings of the American Society of Civil Engineers*. The commonly used method of placing the core results in an exceedingly fine-grained material, but though this is very desirable from the standpoint of a water-tight dam, it may be that the extreme tightness is secured at the expense of stability. For success in using the hydraulic method, it is necessary either to increase the dimensions of the toes until they are large and heavy enough to resist the full liquid pressure of the core, or else to handle the core material so that the finest particles are wasted, leaving only the largest ones, thereby increasing the grain size to a point where drainage can be secured, while remaining sufficiently impervious for practical purposes.

**Local Magnetic Disturbances** of intensity equalled nowhere else in the world were observed for some years by one Professor Leyst in the vicinity of Koursk, Russia. He attributed this to the presence of large undiscovered bodies of iron ore. His data have been rescued and transported to Sweden, where they have been worked over, with the result that it appears the deposits in question must be two in number, each 108 kilometers long, and the largest in the world.

## Astronomy

**Spectrum of Jupiter.**—Mr. V. M. Slipher reports that, with the aid of dyes for sensitizing dry plates for the lower spectrum, he has been able to extend the photographic spectra of the planets into lower wavelengths than were formerly accessible. He has presented to the American Astronomical Society the results of observations of the spectrum of Jupiter, which reveal several new bands and lines due to the selective absorption of the planet's atmosphere.

**Polariscopic Observations During a Lunar Eclipse.** —M. P. Salet, of the Observatory of Paris, reports that the light of the moon during the total eclipse of May 3, 1920, was examined for polarization at that observatory, with Savart polariscopes placed before the eyepiece of a telescope. The different parts of the earth's shadow on the moon showed no trace of polarization. This result does not, therefore, support the observations of Arago, during a lunar eclipse in 1844, and of Zantedeschi and Freeman during subsequent eclipses, all of these observers having reported that they found evidences of polarization in the light of the eclipsed moon.

**The First Astronomical Photographs in Colors** are said to have been those obtained by MM. Gimpel and Touchet of the total lunar eclipse of May 3, 1920, at the observatory of the Astronomical Society of France, in Paris. As this was a pioneer undertaking, no data were available as to the proper time of exposure. The camera was attached to the small equatorial of the observatory, and pictures were taken with exposures ranging from 3 to 40 minutes throughout totality. All proved to be under-exposed except that with the longest exposure, which showed different shades of red coloration and several details of the lunar surface. At the next lunar eclipse the photographers hope to use the great equatorial of the Meudon observatory, which should produce as satisfactory results with an exposure one-twenty-seventh as long. Supersensitized Lumière autochrome plates were used.

## Industrial Efficiency

**Fuel Oil for Railroads.**—The great scarcity of coal has caused the Paris, Lyons, and Mediterranean Railway Company to transform some of its motive power from coal to fuel oil consumption, which is about to be followed by the Chemin de Fer de l'Etat, or State-owned Railway, and engines at its shops at Saintes are now undergoing changes for experimental purposes. Much attention is being directed to the announcement that the first-named railway company is planning to equip 200 locomotives for fuel oil and install numerous storage reservoirs of from 40 to 100 tons' capacity at various points on its lines.

**Germany's Shortage of Gasoline.**—In a recent general meeting of the Society of German Motor Car Manufacturers complaint was made that sales are badly blocked by the shortage of gasoline; that the importation from the United States is, in spite of very considerable orders most unsatisfactory seemingly on account of an enormous consumption in the United States; that it is hoped that Roumania will soon be able (as in former times) to again take up its gasoline export to Germany. In the course of the meeting it was further stated that it was planned to work hand in hand with the Austrian automobile industry concerning all economic questions.

**Pulpwood of Canada.** — Louis Piche, Provincial Forester, estimates that in Quebec there are 360,000,000 cords of all pulpwoods. Of this amount, there are 155,000,000 cords of available spruce and balsam which, at the present rate of cutting, namely, 3,000,000 cords per year, would give about 52 years' supply. It is estimated that there are, in Ontario, 250,000,000 cords of spruce and balsam. Of this it is estimated that at an early date the cut will be 1,500,000 cords, which indicates 67 years' supply. New Brunswick, with 36,000,000 cords of spruce and balsam, and an annual cut of 1,250,000 cords, has sufficient for a twenty-nine years' supply.

**Sea Lion Leather.** — Large numbers of sea lions on the British Columbia coast which destroy annually vast quantities of fish food may be slaughtered and their hides placed on the world's leather market, if a proposition which comes from Premier Oliver and has the approval of many experienced fishermen, is carried out. The sea lion weighs from 2,000 to 2,500 pounds, the hides being nearly an inch thick. These hides make a tough and durable rough leather such as is used in workmen's gloves and in saddles. It is stated that these animals will eat 50 pounds of fish in a day. Four hunters recently killed several hundred sea lions in one day in the Charlotte Islands.

**Traveling Railway Car Exhibit.**—One method of advertising, as effective as the use of motion pictures, is the railway car specially fitted to display merchandise, according to British business men. Accompanying this car (or cars) should be a salesman able to speak the language of the country where the car is traveling and capable of demonstrating the articles exhibited. Even if parts of a model of an agricultural implement or machine be shown, the salesman ought to be able to get a complete machine from a central agency or warehouse in the country where the exhibit is being made and show the practical working of the machine. It appears a demonstration would be a good selling argument. However, most manufactures are not so bulky or difficult to handle as farm machinery. To make sure of reaching business men, farmers and artisans, the coming of the Railway Car Exhibit is widely advertised in newspapers and on bulletin boards. Thus far the results in attendance and interest manifested have been beyond the most sanguine hopes of the promoters of the scheme.

## CONDITIONS FOR THE $5,000 PRIZE EINSTEIN ESSAY CONTEST

1. No essay shall be longer than 3,000 words.

2. All essays must be in English, and written as simply, lucidly and non-technically as possible.

3. Each essa ymust be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted.

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The Committee of Judges will consist of Professors Leigh Page of Yale and E. P. Adams of Princeton. In the event that they are unable to agree on the best essay, the Einstein Prize Essay Editor will cast the deciding vote.

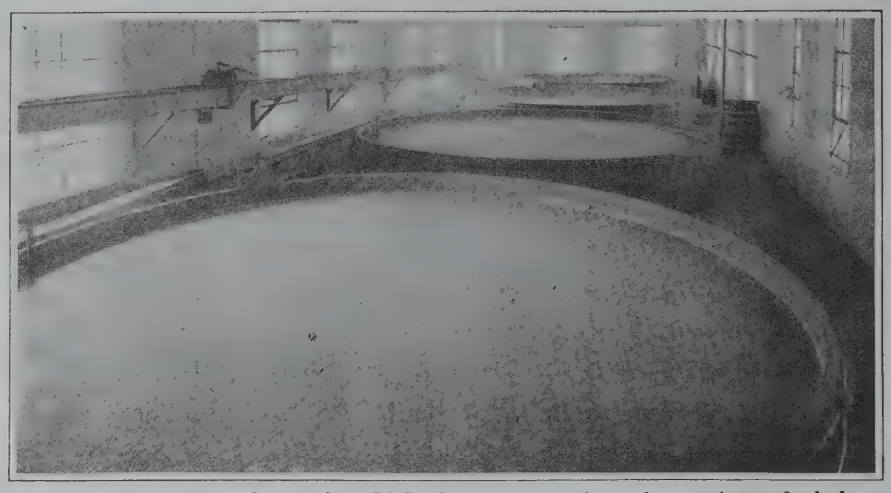
# Shall the Corn Fields Run Our Cars?

## The Possibilities of Synthetic Fuels, and the Source of the Alcohol to Make Them

By Robert G. Skerrett

ALCOHOL will inevitably play a part of steadily increasing importance in our economic life. For many years it has been indispensable to the industrial arts in one way or another, but from now on it will figure more and more in furnishing heat and motive energy. Indeed, the students of the subject realize that we cannot begin too soon to develop our sources of alcohol and to adapt our internal-combustion engines and other apparatus to the use of this liquid fuel.

If one will take the trouble to study the array of advertising matter having to do with automotive vehicles it will be plain that the engineer and the inventor are busy trying to get an augmented service out of a given quantity of "gas." This end is being sought either by the development of auxiliaries of a wide variety or by modifications of the engines so that they can work to better advantage when fed gasoline of lower quality. This procedure is, in a sense, a sop to expediency and does not scientifically strike right at the kernel of the problem.



**Part of a group of vats in which the fermentation of corn into alcohol is carried on**

The manufacture of internal-combustion engines, insofar as the art is directly related to the utilization of gasoline, is in much the same state as was the fabrication of heavy cannon before the evolution of modern smokeless propellants. In the days gone, the ordnance engineer had to design his gun so that it would be strong enough to withstand the gases suddenly and violently generated by black powder. The controlling factor was a mechanical mixture of saltpeter, charcoal, and sulfur. As far as lay in their power, the metallurgist and the gunmaker joined forces, and together larger rifles were turned out capable of holding the explosive gases safely in check. But there was a limit to progress in the matter of weapons using black powder just as there is in the building of engines relying entirely upon gasoline for their impulse.

Next came smokeless powder, a chemical product, and from then on the ordnance engineer was unfettered: he can now pattern his rifle to give definite performances in the way of range and initial velocity. Having designed his gun, he turns to the man of the laboratory to provide a smokeless propellant which will function in complete harmony with the physical characteristics and the intended purpose of each type of cannon. And, let it be said, that in the same general manner we must cease to rely upon gasoline, pure and simple, as a primary source of power and, instead, adopt composite fuels which the chemist will compound for us to meet stated conditions. In these alcohol is sure to figure conspicuously.

Six years ago, a synthetic fuel was brought out in South Africa and subjected to a series of tests which gave excellent results. The fuel was made up of about 60 per cent alcohol, 39 per cent ether, 1 per cent ammonia, and ½ per cent of arsenious acid. The purpose of the ether was to increase the "kick" and to make it possible to start an engine when cold. The ammonia neutralized the corrosive exhaust of the alcohol so that it would not injure exposed metal surfaces, and the arsenic was to denature the mixture.

A synthetic fuel invented in this country has been perfected for airplane service. This is composed of 38 parts of alcohol, 19 parts benzol, 4 parts toluol, 30 parts gasoline, 7½ parts ether, and 1½ parts of some ingredient which is not disclosed, probably a denaturant. The fuel, during a trial period of several weeks, proved to be more economical than high-test aviation gasoline. The carbon deposit was less than is normally the case, and there was a reduction in the amount of lubricating oil required. Composite fuels, as we have them now, are helping to carry us along during the interval of transition from the out-and-out gasoline engine to a motor which may be developed that will be able to use straight or nearly straight alcohol. In either event, the result will be the evolution of engines having superior characteristics; and the fuel, synthetic or otherwise, will be prepared to suit the motor instead of largely dominating its mechanical get-up as now.

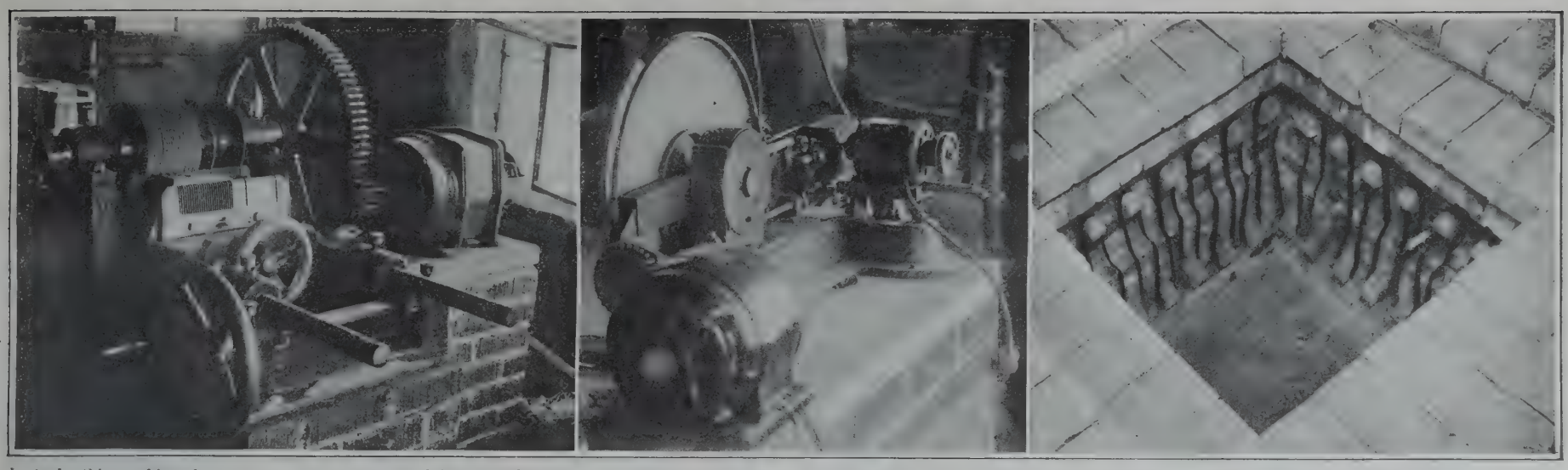
It is a matter of pretty common knowledge among those familiar with the liquid fuel used in automobiles and trucks that benzol is added to some grades of gasoline to improve their deficient "kick," and this ingredient is said to check carbon deposits. Toluol also augments the energy factor. Both benzol and toluol are coal-tar derivatives, and can today be had in immense quantities from our by-product coke ovens and from up-to-date gas houses. But even so, the layman may wonder where we are going to get all of the alcohol that may be needed when we come to depend less and less exclusively upon gasoline.

Hitherto, most of our so-called industrial alcohol has been obtained from sugar-mill waste, i.e., the well-known blackstrap molasses. The amount of this basic raw product is decreasing, mainly because the refiners have brought into play processes which make it possible for them to secure from the molasses various marketable syrups to satisfy the popular sweet tooth. True, low-grade molasses can still be had from the sugar mills of the Far East and other remote sources, but this entails the service of special tank steamers and the added costs of transportation. How, then, are we to produce the great measure of alcohol which we shall want ere long?

(*Continued on page 284*)

*Left:* **Vat in which the yeast is prepared to promote the fermentation.** *Above:* **Mills for grinding the corn preliminary to cooking.** *Right:* **The steam cooker where the ground grain is made into a mash in order to convert the starch to sugar**

**Three steps in the extraction of alcohol from corn**



*Left:* In this machine the sections of shale are sawed into pencil-like strips for subsequent shaping into needles. *Center:* The grinding machine for shaping the needles. *Right:* The electric kiln in which the shaped needles are heated to 2,000° Fahrenheit, in order to give them the proper hardness. Note the strips around the sides of the kiln, which comprise the heating element

**From clay to phonograph needle via various machines and the tremendous heat of the electric furnace**

## Clay Needles for the Talking Machine

**By Allen P. Child**

THERE seems to be no end to the various kinds of phonograph needles. Playing records with a chip of a brick is the latest in phonograph needles—and the invention of an Iowa man. It is claimed that this needle of clay will play, with a very clear tone and with little surface noise, at least 200 times.

The needles are made from a dark red or chocolate colored shale. As the shale has practically no grain, and no grit is present, it is found that a very high polish is taken on where it comes into contact with the record. In making the needle the shale is cut from a bank in sections which are as nearly square as possible and each piece measures about 6 inches. The shale is brought from the clay banks and the sections are stored in sacks coated with paraffine. These sacks serve to keep the air away from the shale as it is liable to air check if exposed to the air when in a moist condition.

The sections of shale are then placed in an electric drier where it is dried very slowly. After thoroughly dried each section is clamped in a vise and is run through a saw which cuts it into pencil shaped strips 3¼ inches in length and ⅛-inch square. The shale pencils are placed on a pallet and are fed automatically into the needle machine where they are pushed out through the head where they come into contact with a grinding wheel with 10,000 revolutions per minute. As they leave the head each pencil revolves at about 600 revolutions per minute. The grinding wheel turns each pencil to a perfectly round needle.

After projecting about ¾ of an inch each pencil comes in contact with another grinder which is set sideways and a perfect point is turned on the needle. A high speed cutting wheel trims the needles to the required length after they have left the grinding machines.

After being placed in fire clay containers they are put in an electric kiln. In the kiln the heat is gradually increased to 2,000 degrees Fahrenheit. Needles are removed when the kiln has cooled sufficiently. The shale vitrifies perfectly at this temperature and is of a dark red color. If not over burned in the kiln the needles are of exceptional hardness.

## The Rocking of a Tall Chimney

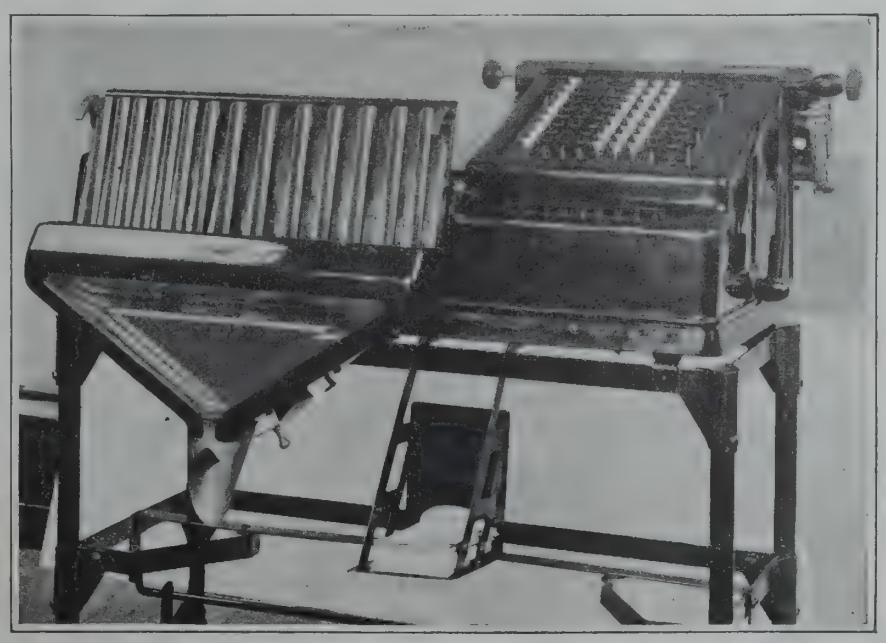
THERE used to be, and possibly still is, in certain quarters of Glasgow, Scotland, where are two of the tallest chimneys, a belief that the tops of those chimneys in high gales of wind swayed as much as 3 feet each way. Both these chimneys are built of brick. The oscillation of a chimney shaft taller than either of the Glasgow ones, built of reinforced concrete, at Saganoseki, Japan, has been carefully watched and measured by a Japanese engineering professor, says a writer in a British trade paper. The shaft is 570 feet in height and has a diameter inside at the top of 26 feet 3 inches. The wind velocities during the observations ranged from one mile per hour, a gentle zephyr, to a hurricane of 78 miles an hour. According to the professor the amplitude of the vibration at the top in a 50-mile wind was no more than 1 inch, that is to say something and nothing, about half an inch each way.

In the 78-mile wind, however, the amplitude was 7.32 inches as a maximum, and curiously enough the movement was not in the direction in which the wind was blowing, but af right angles to that direction. The professor calculates that in a gust of 110 miles an hour, which not infrequently occurs, the amplitude would be at least 15 inches. It is interesting further to note that the time taken for each complete vibration was practically the same whatever the velocity of the wind, the range being merely from 2.52 seconds to 2.56 seconds.

## Fuel Value of Wood

THE fuel value of wood has been the subject of more than one discussion and the following therefore may be of interest. A ton of coal may be taken as the equivalent in heating value of one cord of heavy wood, such as hickory, ash, oak, elm, beech, locust, birch, cherry, long-leaf pine, and hard maple. One and a half cords are required of short-leaf pine, Douglas fir, red gum, sycamore, soft maple, and western hemlock to equal a ton of coal, while in the case of cedar, cypress, catalpa, basswood, redwood, poplar, spruce, and white pine, two cords are equivalent to one ton of coal. Resin in wood gives twice as much heat as the wood itself, which accounts for the fact that the pines and firs have more heating power per ton than non-resinous wood.

It is to be understood that fuel value depends not alone upon heating power, but upon rapidity of burning, ease of ignition, minimum smoke, and uniformity in heat. Pines give a quick, hot fire and are consumed more rapidly than birch, birch giving a more intense flame than oak, while oak is noted for the steady heat it produces.



**This machine, based on the general principle of the adding machine, reduces the erstwhile tedious task of preparing the payroll to a simple mechanical operation**

## Putting the Payroll on an Automatic Basis

**By Charles Abbott Goddard**

MANY are the mile posts of progress along the course which has transformed the old-time office where all writing and computing were done by hand, to the business workshop of today with its battery of typewriters and adding machines, its equipment for duplicating letters and forms of all sorts, its steel filing cabinets, and its private telephone switchboard. "Push the button and the machine does the rest," is a principle that has had marvelous adaptation to every phase of business routine.

A product of this age of office efficiency which has proved its worth is a machine which adds making out the payroll to the long list of business details now accomplished with mechanical ease. For years one of the most trying tasks for every company with a large number of employes has been making up the weekly or monthly payroll.

Although the advent of the adding machine brought considerable relief in this work, there were still many chances for mistakes in handling the cash. Checking up a great number of envelopes already filled to find the error was a tedious business at best. The adding machine assured the accurate adding of the payroll, providing the necessary sub-total and totals, but its usefulness ended when it came to denominating the payroll and actually filling up the envelopes.

Now comes a machine that solves all of the paymaster's problems at once. It operates like a standard adding machine in so far as it adds and lists the payroll, giving the grand total and sub-totals. But it does not stop there. The next step it performs is to denominate the payroll, that is, to indicate exactly how many twenties, tens, fives, ones, half dollars, quarters, dimes, nickels, and cents must be drawn to pay correctly. This is so long and tedious a job that many cashiers and paymasters simply approximate these denominations, carry an extra change account and balance the cash when the payroll is finished. This entails extra bookkeeping and the possibility of having to hold up the entire payroll to send out for more coins if those of any denomination are exhausted.

The payroll machine eliminates this entire problem by indicating instantly when it gives the payroll total, in just what denominations this amount must be drawn to pay each item correctly. The cashier can thereby draw the total payroll amount in exactly the denominations that will be needed, knowing that when the last envelope is filled the last cent will be used.

This remarkable machine goes still further. When the money is on hand the scheduling device is replaced by a coin tray into which all coins, gold or silver, are placed. The operator then runs off each payroll item on a keyboard similar to the standard adding machine keyboard. Each time the operator lists an item and pulls the handle the machine automatically counts out the correct amount of coin and drops it into the employe's envelope, at the same time making a permanent

(*Continued on page 284*)

# New Concepts of the Past Century

## The Change in Outlook Since Classical Days, Which Makes Non-Euclidean Geometry a Possibility

### By the Einstein Prize Essay Editor

THE science of geometry has undergone a revolution of which the outsider is not informed. The classical geometer regarded his science from a narrow viewpoint, as the study of a certain set of observed phenomena—those of the space about us, considered as an entity in itself and divorced from everything in it. It is clear that some things about that space are not as they appear (optical illusions), and that other things about it are true but by no means apparent (the sum-of-squares property of a right triangle, the formulæ for surface and volume of a sphere, etc.). While many things about space *are* "obvious," these need in the one case disproof and in the other discovery and proof. With all their love of mental processes for their own sake, it is then not surprising that the Greeks should have set themselves the task of proving by logical process the properties of space, which a less thoughtful folk would have regarded as a subject only for observational and experimental determination.

But, abstract or concrete, the logical structure must have a starting point. It has been pointed out in these columns that the simplest words cannot be defined in terms of anything still simpler. In any logical structure they must therefore stand undefined. Equally, the simplest facts cannot be proved in the absence of simpler facts to cite as authority. If we are to have a logical structure of any sort, we must begin by laying down certain terms which we shall not attempt to define, and certain statements which we shall not try to prove.

The classical geometer sensed the difficulty of defining his first terms. But he supposed that he had met it when he defined these in words free of technical significance. "A point is that which has position without size" seemed to him an adequate definition, because "position" and "size" are words of the ordinary language with which we may all be assumed familiar. But today we feel that "position" and "size" represent ideas that are not necessarily more fundamental than those of "line" and "point," and that such a definition begs the question. We get nowhere by replacing the undefined terms "point" and "line" and "plane," which really everybody understands, by other undefined terms which nobody understands any better.

In handling the facts that it was not convenient to prove, the classical geometer came closer to modern practice. He laid down at the beginning a few statements which he called "axioms," and which he considered to be so self-evident that demonstration was superfluous. That the term "self-evident" left room for a vast amount of ambiguity appears to have escaped him altogether. His axioms were axioms solely because they were obviously true.

### Laying the Foundation

The modern geometer meets these difficulties from another quarter. In the first place he is always in search of the utmost possible generality, for he has found this to be his most effective tool, enabling him as it does to make a single general statement take the place and do the work of many particular statements. The classical geometer attained generality of a sort, for all his statements were of *any* point or line or plane. But the modern geometer, confronted with a relation that holds among points or between points and lines, at once goes to speculating whether there are not other elements among or between which it holds. The classical geometer isn't interested in this question at all, because he is seeking the absolute truth about the points and lines and planes which he sees as the elements of space; to him it is actually an object so to circumscribe his statements that they may by no possibility refer to anything other than these elements. Whereas the modern geometer feels that his primary concern is with the fabric of logical propositions that he is building up, and not at all with the elements about which those propositions revolve.

It is of obvious value if the mathematician can lay down a proposition true of points, lines and planes. But he would much rather lay down a proposition true at once of these and of numerous other things; for such a proposition will group more phenomena under a single principle. He feels that on pure scientific grounds there is quite as much interest in any one set of elements to which his proposition applies as there is in any other; that if any person is to confine his attention to the set that stands for the physicist's space, that person ought to be the physicist, not the geometer. If he has produced a tool which the physicist can use, the physicist is welcome to use it; but the geometer cannot understand why, on that ground, he should be asked to confine *his* attention to the materials on which the physicist employs that tool.

It will be alleged that points and lines and planes lie in the mathematician's domain, and that the other things to which his propositions may apply may not so lie—and especially that if he will not name them in advance he cannot expect that they will so lie. But the mathematician will not admit this. If mathematics is defined on narrow grounds as the science of number, even the point and line and plane may be excluded from its field. If any wider definition be sought—and of course one must be—there is just one definition that the mathematician will accept: Dr. Keyser's statement that "mathematics is the art or science of rigorous thinking."

The immediate concern of this science is the means of rigorous thinking—undefined terms and definitions, axioms and propositions. Its collateral concern is the things to which these may apply, the things which may be thought about rigorously—everything. But now the mathematician's domain is so vastly extended that it becomes more than ever important for him to attain the utmost generality in all his pronouncements.

One barrier to such generalization is the very name "geometry," with the restricted significance which its derivation and long usage carry. The geometer therefore must have it distinctly understood that for him "geometry" means simply the process of deducing a set of propositions from a set of undefined primitive terms and axioms; and that when he speaks of "a geometry" he means some particular set of propositions so deduced, together with the axioms, etc., on which they are based. If you take a new set of axioms you get a new geometry.

The geometer will, if you insist, go on calling his undefined terms by the familiar names "point," "line," "plane." But you must distinctly understand that this is a concession to usage, and that you are not for a moment to restrict the application of his statements in any way. He would much prefer, however, to be allowed new names for his elements, to say "We start with three elements of different sorts, which we assume to exist, and to which we attach the names A, B and C—or if you prefer, primary, secondary and tertiary elements—or yet again, names possessing no intrinsic significance at all, such as ching, chang and chung." He will then lay down whatever statements he requires to serve the purposes of the ancient axioms, all of these referring to some one or more of his elements. Then he is ready for the serious business of proving that, *all his hypotheses being granted*, his elements A, B and C, or I, II and III, or ching, chang and chung, are subject to this and that and the other propositions.

### The Rôle of Geometry

The objection will be urged that the mathematician who does all this usurps the place of the logician. A little reflection will show this not to be the case. The logician in fact occupies the same position with reference to the geometer that the geometer occupies with reference to the physicist, the chemist, the arithmetician, the engineer, or anybody else whose primary interest lies with some particular set of elements to which the geometer's system applies. The mathematician is the tool-maker of all science, but he does not make his own tools—these the logician supplies. The logician in turn never descends to the actual practice of rigorous thinking, save as he must necessarily do this in laying down the general procedures which govern rigorous thinking. He is interested in processes, not in their application. He tells us that if a proposition is true its converse may be true or false or ambiguous, but its contrapositive is always true, while its negative is always false. But he never, from a particular proposition "If A is B then C is D," draws the particular contrapositive inference "If C is not D then A is not B." That is the mathematician's business.

The mathematician is the quantity-production man of science. In his absence, the worker in each narrower field where the elements under discussion take particular concrete forms could work out, for himself, the propositions of the logical structure that applies to those elements. But it would then be found that the engineer had duplicated the work of the physicist, and so for many other cases: for the whole trend of modern science is toward showing that the same background of principles lies at the root of all things. So the mathematician develops the fabric of propositions that follows from this, that and the other group of assumptions, and does this without in the least concerning himself as to the nature of the elements of which these propositions may be true. He knows only that they are true for any elements of which his assumptions are true, and that is all he needs to know. Whenever the worker in some particular field finds that a certain group of the geometer's assumptions *are* true for his elements, the geometry of those elements is ready at hand for him to use.

Now it is all right purposely to avoid knowing what it is that we are talking about, so that the names of these things shall constitute mere blank forms which may be filled in, when and if we wish, by the names of any things in the universe of which our "axioms" turn out to be true. But what about these axioms themselves? When we lay them down, in ignorance of the identity of the elements to which they may eventually apply, they cannot by any possibility be "self-evident." We may, at pleasure, accept as self-evident a statement about points and lines and planes; or one about electrons, centimeters and seconds; or one about integers, fractions, and irrational numbers; or one about any other concrete thing or things whatever. But we cannot accept as self-evident a statement about chings, changs and chungs. So we must base our "axioms" on some other ground than this; and our modern geometer has his ground ready and waiting. He accepts his axioms on the ground that it pleases him to do so. To avoid all suggestion that they are supposed to be self-evident, or even necessarily true, he drops the term "axiom" and substitutes for it the more colorless word "postulate." A postulate is merely something that we agree to accept, for the time being, as a basis of further argument. If it turns out to be true, or if we can find circumstances under which and elements to which it applies, any conclusions which we deduce from it by trustworthy processes are valid within the same limitations. And the propositions which tell us that, *if* our postulates are true, such and such conclusions are true—they, too are valid, but without any reservation at all!

### What May We Take for Granted?

But how does the geometer know what postulates to lay down? One is tempted to say that he is at liberty to postulate anything that he pleases, and investigate

(*Continued on page 286*)

*WHEN the Einstein essays begin to appear in print, it will be found that many of them will have something to say about the non-Euclidean character of the geometry of the Einstein four-dimensional time-space manifold. This sounds like a very large order but it is not half so bad as it sounds. The competing essays, however, will not be able, in the space allotted, to give this phase of the subject anything like the background which it ought to have. It seems that such background may properly be supplied in advance rather than as an afterthought; so the Einstein Prize Essay Editor has prepared the accompanying material which, with another article in a later issue, aims to make it plain just what the mathematician is getting at when he talks of non-Euclidean geometry. We have asked this member of the staff to try to make good on the boast, which he recently incorporated into a review of Einsteinian literature, that he tries to be a human being. We hope that he has succeeded.*—THE EDITOR.

# Shortening the Route from Farm to Consumer

## One Way to Do This by Reversing History and Extending the Rôle of the Farm

By John T. Bartlett

SOME farmers only crop the land, as in grain farming and orcharding; a greater number both crop the land and raise livestock, utilizing the feed produced; a very small number crop the land, turn the crops into livestock products and then process the livestock products for consumption by the consumer. Are economic conditions such in America at present that there is an opportunity for the farm which is a complete factory, turning out a finished consumer product? This is a debatable, but important question.

Certainly such practice cannot become general in all branches of farming at present, since it would involve the milling of grain, the packing of meats, and the cooking and canning of fruits and vegetables on a scale which only a ridiculous minority of our growers could possibly contemplate. Even so, however, the dairy industry and the associations of fruit growers which have sprung up in various parts of the country show a tendency to undertake just this task on a cooperative scale; and here and there we find cases where the individual farmer is going in for a complete handling of his product. One $300,000 farm enterprise in the Northwest is predicated on a belief that the time is opportune for a type of large farm which performs every step, except retailing, in the production and distribution of such staples as butter, eggs, and all kinds of meats.

This is a property of 2,500 acres, intensively developed for the past ten years. It has a poultry plant which at times has held as many as 4,000 head. The intention is to standardize at 8,000 head. Dairy barn facilities are for 200 head of cows. The hoghouse has a capacity of 2,000 head. These are large-size buildings, as farm structures go, but not especially unusual. The interesting thing is that the farm equipment goes much further. It includes a $35,000 packing house, built in 1911 of tile and concrete and with a complete equipment all the way from slaughter room to storage. There is a creamery which has a capacity of 60,000 pounds a year.

Several score years ago both creameries and packing houses were unknown in the twentieth century sense. Butter was formerly wholly made on farms; now it is made in large or small creameries, some owned by coöperating farmers and others by private interests. Before cream is manufactured into butter nowadays it typically travels anywhere from several miles to two or three hundred from the point of production.

The same thing has happened in meats. Beef, pork and mutton were once slaughtered, cut up and cured on the farm where produced. Then came local slaughter houses and finally the great centralized packing plants of the present day. Farmers still do considerable slaughtering for home or neighborhood use, but practically no other. There was a time when the farm was a complete farm factory, and when its functions were not complete until it had prepared the product for the consumer. The whole trend of the times has been away from this condition.

Now, with the development of a higher level of merchandizing ability among farmers will farm enterprises which go back to the old function—with a difference—become extensive? Do economic conditions provide a place for such farms?

The experience to date of the Washington project is not conclusive. The farm has demonstrated one thing, that in its particular case it is not practical to cut out the retailer, building distribution on the parcels post. The original intention was to do this, and an extensive mail trade was built up, but the plan proved unprofitable. The present arrangement is distribution through the retailer. A retail store in Tacoma specializes in the farm's products; the farm trade-mark is featured, and a lunch counter is made an effective trade-builder. Working along these lines, the management believes its methods are economically sound.

On the other hand, a New England farm near Springfield, Mass., having a smaller output than this one in the Northwest, has established a system of consumer routes. A wagon carries eggs, butter and vegetables in summer and in winter these and such home-made country products as hulled corn, hominy, sausage meat, jellies, pickles. The farm is very careful in selecting a salesman. No ordinary farmhand will do. He must know how to sell, and how to build up good will. He is paid a salary and commission.

Again, one of the largest mixed farms in New Hampshire has for years eliminated all middlemen and marketed direct to the consumer, but here the consumer is a large Boston hotel which owns the farm. Butter, meats, fruits, etc., are produced. It is understood the farm thus operated is profitable. A big chain restaurant with establishments in many eastern cities did the same sort of thing for many years.

In all such methods to shorten the distance between farm and consumer, management is a critical factor. No plan of doing business is "fool-proof." There must be clever, shrewd management behind it to make it a success. The fact that many attempts to market in a new way have failed is indubitably partly attributable to the fact that inexperienced people have launched many such ventures.

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### Some More Newspaper Astronomy

To the Editor of the SCIENTIFIC AMERICAN:

I was much interested in the article you had some weeks ago about the misinformation that was published in the Albuquerque paper. I ran across one yesterday in the *Los Angeles Times* that seems to me even worse, and thought you might appreciate it. It occurs in the "Questions Answered" column of this sheet, and is in reply to an inquirer who wants to know why the moon isn't always round. The oracle tells him:

"The moon is always round, but its changes in appearance are due to the earth's shadow being thrown upon it as the earth passes between the sun and the moon. The size of the shadow varies each night that the moon is visible."

It would seem that this explanation leaves something still to account for. So far as I know the earth is always the same size, and therefore it seems rather extraordinary that its shadow should vary in magnitude. Also, why the reservation about the nights when the moon is visible? Are we to suppose that no moon is merely a total eclipse?

Still, we shouldn't be too hard on him. Doubtless the same member of the *Times* staff attends to the astronomical queries and the advice to the lovelorn, and too great accuracy should not be expected of one who adopts such widely divergent specialties.

Los Angeles. A. E. T.

### Protect the Standing Train

To the Editor of the SCIENTIFIC AMERICAN:

I would respectfully ask, in view of this last terrible accident on the New York Central, if it would not be pertinent to again call attention to the absolutely criminal carelessness of leaving the rear of a standing train unprotected, as well by derail as by signal. A train might run by signals, but never by a well-placed derail.

If not in this case, the particulars of which are not at hand, certainly in most cases, there is time to place a derail in addition to the ordinary signals, and seldom would a derailed train work the havoc to itself that it would by crashing into the rear of a standing train. GEO. T. PAINE.

Waterville, Me.

### Pure Water at Low Cost

To the Editor of the SCIENTIFIC AMERICAN:

Inasmuch as the question of pure water is an important one in every household, and as the supply of pure water is not always available, I will briefly outline a simple means of obtaining the purest of water (distilled) at a minimum of cost and with no other appliances than those found in the average kitchen.

I use an aluminum tea-kettle and a quart glass milk bottle. I have the milk bottle tilted so that its bottom is about six inches above the lid of the kettle, the neck of the bottle passing over the spout of same. Very little heat is required to keep the water in the kettle at a boiling point, and the condensation, drop by drop, will amount to a quart, without interfering in any way with other kitchen work.

Inasmuch as the ordinary means of distillation is complicated and expensive, this simple way in which I obtain absolutely pure water is worth passing on.

Rhinelander, Wis. J. C. TEAL.

### The Origin of Coastal Ripple Marks

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to ask the attention of the author of the article on the *Geology of Ripple Marks*, and of your readers, to a theory I have reached during ten years of study of the method of their formation.

It has seemed to me that these markings are usually, if not always, caused by water driven upshore by the ocean waves and the forming of little pools or lakelets in depressions of the sand by the lowering tides. As the tidal ebbing continues the water in the little ponds seeps through the sand, seeking the lowered level of the adjacent water. In doing so the scales of hornblende and quartz are sorted, compacted, and wrinkled by the currents of sinking sea-water into the characteristic contortions and ripples. An admixture of mud in the higher levels results in the larger and more contorted wrinklings.

Atlantic City, N. J. GEO. M. GOULD.

### Life on Mars?

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of March 20th the insistent problem of life on Mars is attacked by a correspondent, C. Fitzhugh Talman, an avatar of Martian habitability. Mr. Talman writes in fine conservative vein as he seeks to "revert to sanity on the subject." He summarily dismisses the possibility of biological evolution on Mars, stating that "nothing we know of the evolutionary process warrants such an assumption."

I deny the validity of this sweeping assertion, and thereon join issue with Mr. Talman.

Nearly every biologist knows that, glowing in the photospheres of distant suns and buried in the soil of alien planets, there exist the same chemical elements that compose the organic creations on this earth—sodium, nitrogen, calcium, carbon, oxygen, et cetera. When a planet cools to the "terraqueous" epoch, as the late lamented Doctor Percival Lowell termed it, these chemicals are brought into play in the planet's life history.

Mammalian structures, increasingly complex and elaborate, originated in the depths of our hot primæval oceans, later to emerge upon the land areas. In even the "least propitious milieu" they found the means of sustenance and growth, and forthwith proceeded the drama of life on our planet.

True, the latitude within which Nature can adapt her creatures is generous, yet Huxley's protoplasmic life-molecule only functions and survives within limits from 32° Fahrenheit to 107.6° Fahrenheit at the upper extreme. Exposure for brief periods to higher temperatures, such as 150°F. and 160°F. in Death Valley is possible, but generally tends to evaporate the water in the tissues and coagulate the albumen in the bodily fluids.

Now, Doctor Lowell demonstrated from Merriam's survey of the San Francisco peaks in Arizona that the maximum summer temperature during the breeding season to which high mammalian orders were exposed—not the rigors of winter cold—determined the possibility of survival. He furthermore showed that the climate of Mars must resemble that of an elevated plateau in a desert region such as Arizona.

Several years previously Arthur Stentzel, analyzing the problem on mathematical grounds, arrived at a mean annual temperature for the poles of Mars of about +12°F.—far higher than its distance from the sun implies. But as summer comes on, the temperature at the Martian equator rises to the mean annual value of 98.1°F. or ten degrees higher than the earth's. This amply included and justified the upper limit determined on less exact data by Doctor Lowell in his work, "Mars as the Abode of Life" a few years previous.

San Francisco, Cal., U.S.A. DONALD P. BEARD.

# Running the Gauntlet of Quality Production

## The Tests That an Automobile and Its Parts Have to Meet Before Passing from the Factory

By Ralph Howard

INDUSTRIAL Europe has long recognized with grudging admiration the cheapness and speed of American standardized quantity production. It has in general felt itself unable to compete with our methods, but has comforted itself with the belief that these methods could never equal the supreme quality of jobs produced by the hand-fitting work of their skilled mechanics.

This was true for a time, but is true no longer. American shops are now turning out work which is both standardized and of supreme quality. There is a considerable number of our factories which can produce goods equal in every way to the best Europe has ever made, and with the added advantages of standardization. American watches are now equal to the Swiss, American machine-made shoes are as good as the English hand product; American machine tools lead the world.

Recognition of this advance in the quality of our production has come very slowly, even at home. Abroad it has barely begun to appear. The reasons for our success are little understood, yet they are simple, and when once known show why our methods not only do produce the highest possible work, but must inevitably do so. They are a skilful combination of science and art, applied rigorously to industrial processes. Perhaps the best illustration of this, because of the wide range of work done, the large number of operations involved and the severe tests to which the product is put, is to be found in the automobile industry.

Under the old system a skilled man achieved accuracy in the assembly by making each part fit the part with which it was to work. The final touches were by hand. The fit could be made exact. Under the modern method there are no final touches to be put on when the parts come to the assembly lines. They have been finished with such accuracy that each will fit into place perfectly without further attention, and fit as well as by any possible skilled adjustment.

There are about 2,300 individual parts put into a big passenger car, ranging all the way from the tiniest screws to the two-hundred-pound cylinder-block castings. The magnitude of the task of having each one of these parts come to the assembly line perfectly fitted to take its place with any other part chosen haphazard from the stock bins can be seen. Yet it is accomplished by a wide and rigid system of inspection under which it is almost impossible that any unfit part can reach the stock rooms. The errors that occur are negligible; they are always corrected by the further inspection of the assembled product that finally takes place.

The extreme degree of accuracy which is insisted upon in the machining of parts is shown by the limits of tolerance which are permitted on inspection. These of course vary widely; it would be merely extravagance to demand hair-line accuracy in a door-latch, or a profile accurate to the thousandth of an inch in the fan. But to say of the machining of the working parts that they were merely accurate to a hair's breadth would be a libel. Many of them are four or five, and some ten times, as accurate as that.

In one car tolerances that come within a thousandth of an inch are too numerous to list. There are 331 of them—and each of these is an accuracy to half the thickness of the finest human hair. Of these 81 are on the rear axle and brakes, 29 on the steering gear, 72 on the clutch, 102 on the motor and 47 on the transmission. But there are nineteen processes which are permitted a tolerance of only half a thousandth; there is one that is held to three ten-thousandths, there are three to .00025 and two to two ten-thousandths of an inch. These tolerances are, for practical purposes, absolute. They cannot be exceeded except in the laboratory, at carefully fixed temperatures, since the heat of the hand will cause a variation of at least a ten-thousandth of an inch in a three-inch standard steel measuring block.

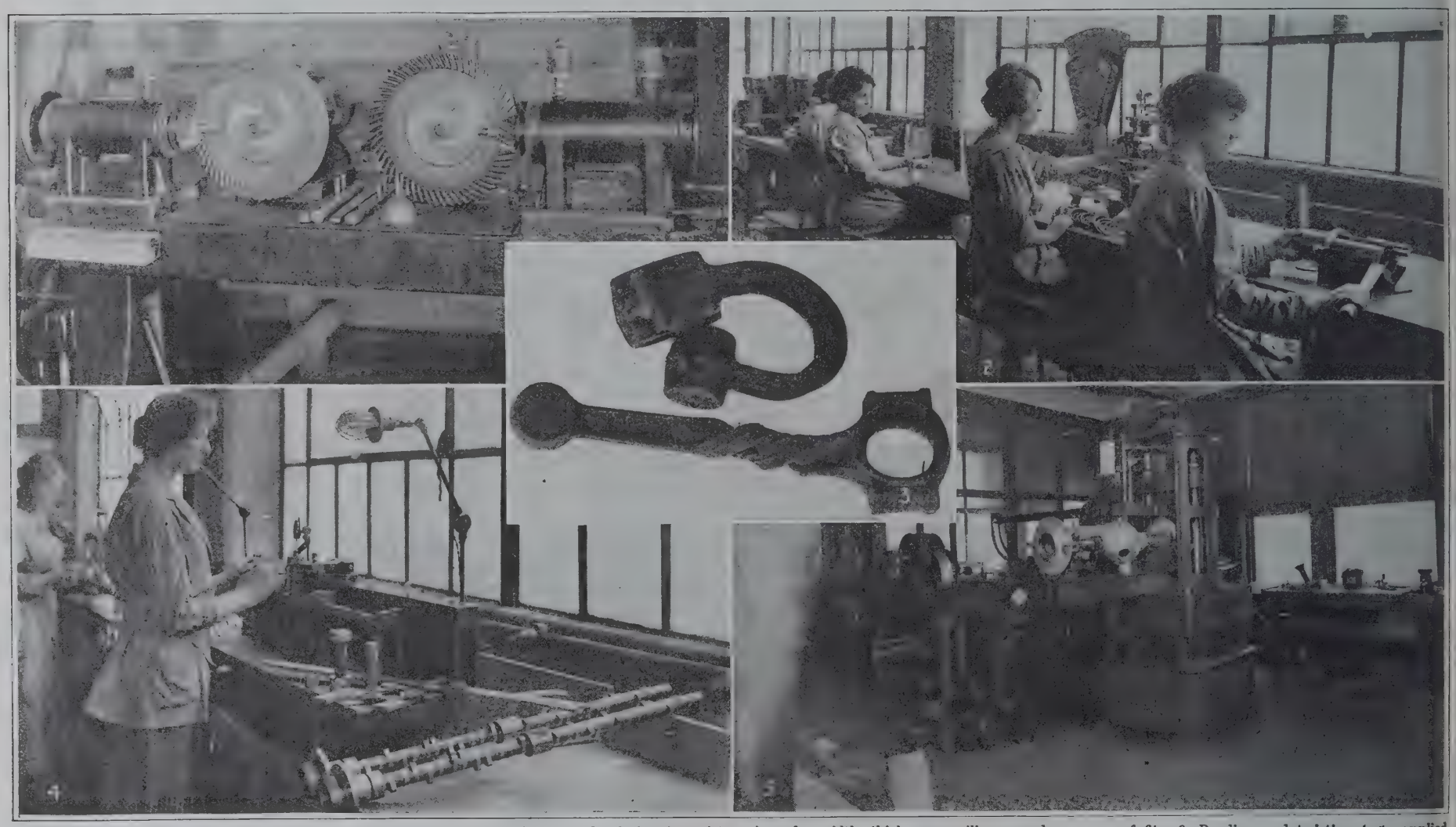
To maintain the inspection which will insure such accuracy is one of the most costly, as it is the most necessary, factors in quality production. Approximately one employe in every twenty is an inspector, and in addition minor executives, like the jobsetters, have definite inspection functions. The mass of gages necessary is staggering. There is a total of some 15,000 in constant use; of these 3,000 are to a thousandth of an inch, and they are kept accurate by constant inspection which brings each one to a testing machine about once every three weeks. It is needless to say that with such accuracy demanded on inspection of parts, there is a most careful inspection also of drills, jigs and bushings, to insure that inaccuracies do not creep in during machining.

All inspection is by blue print specifications, and for many of these inspections special gages and profile forms have to be used. So small a thing as a valve, for instance, is inspected on nine different points. The slot is tested for width and length. The stem is ring-gaged for its entire length. A profile gage is used to test the length and the angle of the face. Both the face and the end of the stem are tested on the scleroscope for hardness. There are 24 such valves to each engine—a total of 216 inspection operations for the engine valves alone.

The steering rod calls for 26 inspections, and a total of 43 inspection operations, since several tests have to be made at different points. There are six tests on each piston ring. Each of the 60 teeth on a transmission gear is tested separately, not to mention the inspection for other points on the gear.

The cam shafts show how complicated the inspection must sometimes become. These are steel shafts, about three feet long, with bearings at either end and a gear at one end, and with two dozen cam wheels. Each of these wheels must be tried in a special gage to insure accuracy of eccentricity and accuracy of placement for timing; each must be tested on both faces for hardness. The tolerance on the machining is one thou-

(*Continued on page 288*)



1. If the gear does not run noiselessly when tested on this motor it is rejected. 2. Testing piston rings for width, thickness, resilience, and accuracy of fit. 3. Bending and twisting tests applied every little while to connecting-rod blanks taken at random from stock. 4. Gaging cam-shafts to insure that they will give accurate timing. 5. Crushing an axle-housing in a machine capable of exerting a pressure of 100 tons

**A few of the many tests that make the automobile the reliable, standardized machine that it is**

## Coasting With Wheels Instead of Runners

IT appears that coasting is pretty much of an all-year-round sport in Switzerland. Indeed, no sooner does the snow disappear and the warm weather is well under way than the sled is replaced by a small three-wheeled coaster of the general type shown in the accompanying illustration. This vehicle is steered by means of a simple handle controlling the single front wheel. A set of brakes operated by foot controls serves to check the speed during the downward rush over the smooth roads.

**With the advent of warm weather the Swiss tourists abandon the sled and turn to the three-wheeled coaster**

## Raising Two Million Baby Trees

FROM the moment the tiny seeds are placed in beds until the bedraggled "monarch" of the forest yields to the storm and stress of years, trees are not impervious to the undermining depredations of insects and rodents. Mindful of this fact, Uncle Sam establishes safeguards around the seed bed as well as jealously guards the grown-up trees in the National forests.

Acreage devoted to sprouting young trees for transplanting 7,000 acres of land annually is covered with fine screening as a protecting influence against insects and rodents that would uproot the otherwise promising crop. A type of screen recently devised for this purpose is so constructed that the sides as well as the top are detachable, thus permitting of storage in compact space when the screening is not in use.

Seeds selected for perpetuating the National forests are assembled by the U. S. Forest Service the previous fall for planting the following spring. Germination tests are first made to determine the vitality of the seed, after which they are sown in beds at a rate sufficient to yield about 150 trees to the square foot.

Ordinarily, Uncle Sam replenishes his diminishing stock of trees in the National forests at a rate of 1,000 young trees to the acre. Couple this fact with the production of 150 trees to the square foot in the seed bed and you can calculate the mileage of screenings used in safeguarding the plant life from its enemies. The seeds are brought to fruition in large nurseries, the photograph showing a seed bed with a capacity for producing about 2,000,000 plants. The view is of the Savenac Nursery in Lolo National Forest, Montana.

**One hundred and fifty trees to the square foot are raised in these screened-in plots of ground, or a total of two million plants at Montana U. S. Forest Survey nursery**

## Can We Fire-Proof Aerial Mail?

THE witticism of the experienced aviator, "Flying is perfectly safe—that is, unless you happen to fall," is taken literally in a re-fashioned adaptation by the United States Post Office Department in establishing safeguards around the aerial mail service. Disastrous crashes of mail-transporting machines at Baltimore, Cleveland and elsewhere, resulting in the loss of postal pouches from fire, have proved canvas cloth thoroughly immersed in sodium silicate to be ineffectual in protecting the mails. Consequently, the one-piece asbestos container has been adopted for installation in twenty parcel-carrying airplanes. Ten yards of asbestos cloth, with an equal measurement of khaki cloth, of 12-ounce weight, is the composition of the fire-resisting material. The asbestos cloth is of substantial quality, weighing 2¼ pounds to the square yard, and the container is bound together with 1,500 copper rivets. It is made secure in the airplane by thin steel strips and screws having great power. Asbestos buckles and straps are used in fastening the mail in the compartment of the plane. The baggy covering has a capacity for snugly enclosing eight of Uncle Sam's largest No. 2 mail pouches, affording protection for 320 pounds of postal matter. The maximum capacity of mail-carrying planes is 620 pounds. Three different types of asbestos containers are being installed. Twelve DeHaviland planes, six of the new type R-4, and two of the old type R-4 machines are being equipped with containers. The containers are being constructed by the Mail Equipping Shops in Washington.

A series of tests has been conducted by officials of the Post Office Department at its landing field, College Park, Maryland, to determine the reliability of the containers in safeguarding mail from conflagrations. A pouch of dummy letters, enclosed in the asbestos covering, placed in a barrel of shavings which had been soused in a gallon of gasoline, then applying the torch, was the basis of the experiment. After being subjected to intense heat for twenty minutes, the mail was removed. With the exception of the packages of letters on the outer edges of the container being charred, the mail was practically intact.

A spraying apparatus for shooting fire-extinguishing liquid in the mail, gas and engine compartments of the airplane; an automatic ignition interrupter, and the placing of an asbestos bulkhead between the gasoline and other compartments of the plane—these are the fire-resisting precautions designed to increase the efficiency of a mail service that is hazardous at best.

Copyright Harris & Ewing

In burning a pouch of dummy letters enclosed in asbestos for 20 minutes, only the edges of several packages of letters were charred

**Fire-resisting qualities of an airplane mail bag**

## Spoilage of Corn

IT is well known that every year thousands of tons of sound corn deteriorates or spoils during storage and transportation. According to one authority, during a period of four months in one year the deterioration of corn arriving in the Chicago market exceeded the value of four million dollars, and the problem of keeping meal in a state suited for human consumption has long been a problem. In view of these circumstances, a study has been undertaken at the Kentucky Agricultural Experiment Station. The conclusions state that excessive moisture is the principal cause of deterioration and spoilage of corn. If the moisture does not exceed twelve per cent, sound grains can be preserved for a considerable time. Such grains will readily absorb moisture if exposed to air in which free moisture exists, and molds, which cause the very rapid deterioration of oil and starch in corn will develop on grains containing fifteen per cent of moisture even at normal temperature if the ventilation is inadequate. If twenty per cent of moisture be present fermentation, producing alcohol and acetic acid, takes place under similar conditions. The danger during exportation is probably due to the failure to dry the corn before placing it in the holds and in not keeping the moisture below twelve per cent during the voyage.

In the case of corn meal, the germ seems to contain an easily oxidizable substance which, when exposed to the atmosphere, produces an acidity, which however will not develop if the corn meal is deprived of its moisture. If the temperature be lowered the development of acidity is retarded. Meal made from degermed grains is inferior to that made from whole grains and the latter, if it does not contain over twelve per cent of moisture, can be kept away from moisture and held in a condition fit for human consumption for some four to six months.

## A Fire Caused by Water

A FIRE which was somewhat unusual in its origin occurred the other day in a dwelling-house in England, says a writer in an English paper. It started in the fusebox containing the fuses for the various lighting circuits in the home. The box was attached to the kitchen wall, and immediately above it ran the two pipes supplying the hot-water system. When the kitchen fire was out, the water in these pipes was, of course, cold, so that they acted as a surface condenser on the kitchen atmosphere, and a steady drip of condensed water took place down the kitchen wall. The pipes were whitewashed, and the condensed water in consequence carried with it a certain amount of calcium carbonate, which destroyed the rubber insulation of the conductors at the point where they passed from the metal tubes in the wall into the fusebox. In turn the copper conductors were corroded with the formation of copper carbonate, and finally the section of wire remaining was so small and its resistance became so great that it got red-hot with the current passing, and set fire to the insulation, spreading ultimately to the woodwork of the fusebox. Fortunately, the failure of the lights gave warning and allowed the fire to be extinguished before any serious damage had been done, but if it occurred in middle of the night, when a light was switched on for a few moments only, the results might have been very different. Of course, no good electrical engineer would place a fusebox or any electrical apparatus on a wall which was liable to dampness, but in these days, when so many people are calling themselves electrical engineers with nothing more to support the claim than an elementary knowledge of wiring, the householder cannot be too careful.

**Sardine fishing and canning plant on Monterey Bay, California**

# From Fish to Food

## How the Toothsome Sardine Is Prepared for the Market by Regular Factory Methods

### By Arthur L. Dahl

BIG industries, as well as big events, grow out of little things. The sardine is probably the smallest fish utilized for food, and yet the canning of this toothsome morsel is developing into a very large industry on the Pacific Coast. We have often heard of a tail wagging the dog, and the sardine industry is a case in point, for its beginning in southern California grew out of the exigencies of another fish-canning industry—that of the tuna. Tuna fish are large, very undependable in habits, and although canned tuna is a strong rival of the salmon, the conditions surrounding the tuna-packing plants were very unstable. There was either a feast or a famine of the big fish, and to stabilize conditions somewhat the packers turned their attention to utilizing some of the small fish caught by the fishing fleet operating in the vicinity. The first sardine canning was done merely as a side issue, to keep down overhead, but its development has been so rapid that now the sardine industry outranks that of salmon fishing in many parts of the West Coast.

The type of sardine packed on the Pacific Coast, is larger than its eastern cousin, or those of European countries, but the meat is fully as good in flavor and texture, and the western sardine is rapidly coming into favor because, the fish being larger, more food can be bought for the same amount of money charged for the smaller fish of the East.

The sardine occurs in great abundance along the entire west coast of the United States and southward on the coast of lower California. It is taken the year round and is especially abundant from September to December. It spawns in the spring. It is an oily, delicately-flavored fish that resembles very closely the European sardine.

The principal sardine fishing-grounds are off the Coronado Islands, in La Jolla Bight, off Redondo, at Santa Monica, Newport and around Santa Catalina Island, in southern California, and in and about Monterey Bay and at Santa Cruz in central California. A number of commercial sardine-packing plants have been established near the fishing grounds, and in these plants the most modern equipment has been installed for cleaning and canning the tiny fish.

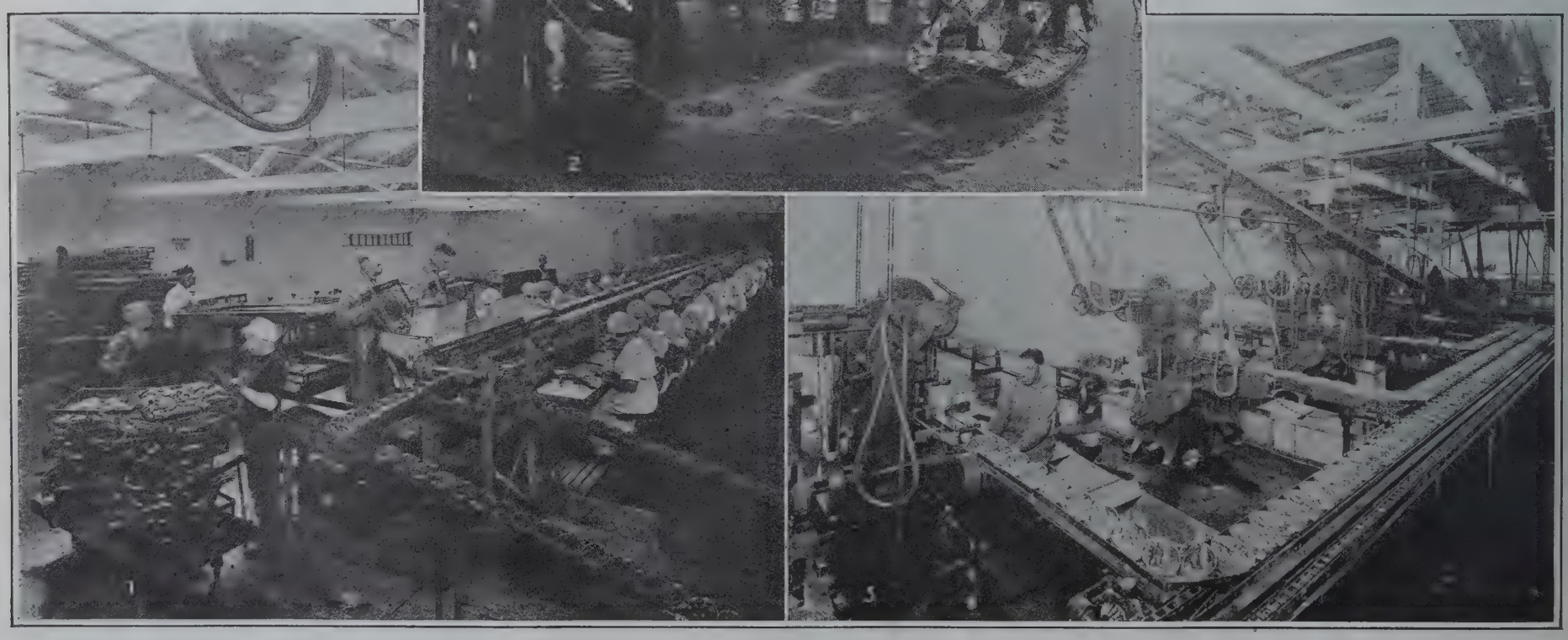
Off the coast of Maine, where numerous packing plants are located for the handling of sardines, the fish are caught largely by the use of weirs, but in California this method cannot be used because the coast sheers off into deep water. There are no flats and no places to put weirs, and the only way one can get sardines is to go out with nets. The Japanese and Italians are especially efficient and go out just before daylight, and by the phosphorescent gleam in the water can encircle a school of sardines and bring them in. Sometimes they get so many they cannot land them in the boat. To prevent the fish from being mutilated by piling them too deep in the fishing boats, various regulations have been promulgated by the fishing authorities limiting the height of the fish in boats.

The sardine fisherman ordinarily use a round haul or circle net, about 1,200 feet long, 50 feet deep in the wings and 150 feet deep in the bag. A line of corks are fastened along the upper edge and a lead line along the lower edge. The mesh ranges from ½ inch in the bag to 3 or 4 inches in the wings.

The net is kept in the stern of the boat, and when a school of sardines is sighted one end of the net is let out and the boat circles about until the net is entirely out and the two ends are close together. It is then slowly drawn in by hand until all of the fish are forced into the center of the bag of the net, where it is an easy task to scoop them out with wire scoops.

At first the fisherman would merely dump the fish into the boat to a consid-

(*Continued on page 290*)



1. Filling the cans with the raw sardines; the upper conveyor brings the empty containers to the girls, and the lower belts carry away the filled cans. 2. Where the sardines come from—hoisting a catch from fishing boats to cannery. 3. Clamping on the lids. The boxes are carried on the belts to and through the capping machines, and with hardly a pause on to the cooker.

**Three stages in the process of converting sardines from fish to canned food**

**Left: German "biscuit" porcelain coins, 2, 3 and 5 mark pieces. Right: Siamese porcelain tokens issued by gamblers but prohibited in 1871**

## German Porcelain Money—An Old Idea Revived to Offset Cheap Marks

IT is now proposed to issue coins in Germany of a denomination of 2, 3 and 5 marks of porcelain. The mark has depreciated to such an extent that it would hardly pay to coin it in anything more valuable than copper or iron, and porcelain seems to be an excellent medium of exchange. Municipal coins particularly for use on cars, "tram currency," are now in use in Hamburg and other cities. The factory facilities are large at Meissen and there is nothing specially to make at present so that there seems to be no reason why porcelain coins should not be manufactured at the erstwhile plant that turned out vases and wonderful dinner sets. The coins are very sanitary, as to clean them it is only necessary to throw into water. Owing to the technical plant required for their fabrication—we cannot say minting—they are very difficult to counterfeit. Porcelain coins are not new, as two of the old English potteries adopted "china" or porcelain tokens. They were made at Worcester in denominations of one and two shillings. In 1801, five and seven shilling tokens were issued at Pinxton. These were oval in shape, flat on one side and convex on the other side, which bears the value in large figures. They were called "chang" or "chanu" money, a dialect corruption of the word Chinese.

It is the oriental use of porcelain for coinage which possesses the most interest. Siamese porcelain tokens were in use from the middle of the 18th century until 1871 when they were forbidden. The majority of these pieces were issued in Bangkok, largely by gambling houses, the fraternity at that time having an enviable reputation for honesty! There are at least 890 known kinds. They occur in a great variety of shapes, colors and values. The denominations are on the reverse and are generally in blue. The native name of this currency is "Pi." The inscriptions are usually in Chinese as the gambling houses were usually owned and operated by Chinese.

The origin of the coins or tokens is interesting. Gamblers in Siam squatted down on an oblong mat at one end of which the cashier or *croupier* was seated in a kneeling attitude. The coins which changed ownership so frequently were thrown a considerable distance, and, being bullet-shaped, often rolled in the wrong direction. To remedy this the owners introduced special counters like the well-known "chips" with which the average red-blooded American is entirely familiar. In time porcelain was adopted and the use of the counters was gradually extended to general use as they were issued under authority granted in the gambling license or concession. So they rapidly became a medium of exchange and were found to fill a long-felt want for small money, but the circulation went beyond its legal sphere. Counterfeits soon made their appearance and the gamblers made constant changes in the size, shape and colors for they are found in round, oval, star, lozenge, gourd, leaf, butterfly, bat and fish shapes. Finally the government interposed and would not allow the tokens to circulate as money although they probably still pass muster in the games of "fan-tan" or whatnot which so interest the Celestial. There is a large collection of these tokens in the Museum of the American Numismatic Society in New York. For our photographs we are indebted to our valued English contemporary the *Illustrated London News*.—By *A. A. Hopkins.*

## What Automobile Racing Does to the Delicate Machinery Called Man

WHEN Gaston Chevrolet climbed from his little green racing car after winning the 500-mile International sweep stakes automobile race at Indianapolis recently, after having driven steadily for nearly six hours at the average speed of 88.16 miles per hour, his eyes were almost lifeless. In medical phraseology they were "dead." His face was haggard and drawn. The muscles of his legs and forearms were cramped and knotted. His head drooped and his steps faltered.

In fact he looked like a man who had just taken a dose of poison.

And that is exactly what happened!

The strain of clutching the wheel of his car for more than five hours and forty minutes, never once relaxing his hold or taking his eyes off the dizzy white stretch of brick pavement always ahead of his speeding machine, had caused physical fatigue equivalent to poison, for fatigue is defined as poison by prominent medical authorities. And fatigue poison is just as effective in its action as arsenic or carbolic acid. An overdose of either would be fatal.

The accompanying pictures tell the story of Chevrolet's complete exhaustion. One shows him, fresh, alert, smiling and full of energy, ready for the gruelling 500-mile race. The other shows him, gaunt, and haggard of face, with colorless eye, drooping head, sagging body and cramped muscles, as attendants helped him from his car after the race, and assisted him to his garage. It is hard to believe that the two pictures are of the same man—yet a period of only slightly more than six hours elapsed between their taking.

"The extreme exhaustion suffered by Chevrolet from physical exertion and severe strain of driving 500 miles without a stop at the terrific speed he maintained," declares Dr. Clyde Leeper, a medical expert of Akron, Ohio, "caused certain chemical changes to create poisonous decomposition in the muscles of his body—in other words the production and accumulation of waste substances such as carbon dioxide and lactic acid. In large quantities these are typical fatigue poisons.

"Chevrolet after the race had the 'dead' eye which we found so often among wounded men overseas, among men who had endured long suffering from wounds and exhaustion and men who had become shell-shock victims. Chevrolet's extreme fatigue was equivalent to a severe shock to the complete nervous system—almost the same as if he had been hurled forty or fifty feet in an explosion, and severely stunned. Bicycle riders, marathon runners and long distance swimmers suffer similar fatigue. They all have that 'dead' eye after the acid test of endurance."

Chevrolet's muscles were so cramped his fingers had to be pried loose from the steering wheel. Huge knots in the muscles of his forearms had to be massaged and rubbed down. And chemical action in his body, created by the extreme exertion and strain, caused him to lose several pounds during the race.

Other drivers suffer similar fatigue, many in shorter races. The faster the speed maintained, the more severe the physical strain. For instance, at Beverly Hills when Art Klein drove the 50-mile speed classic at the rate of 111.8 miles per hour, his fingers were clamped to the steering wheel so tightly they had to be pried off. He was powerless to relax the death-like clutch.

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**The "before and after" of automobile racing: Gaston Chevrolet at the start of a 500-mile race, and just after winning it**

# The Romance of Invention—XVII

## The Heart of the Gas-Filled Lamp—Ductile Tungsten and the Man Who Made It

By C. H. Claudy

IT is a conservative estimate to say that the use of the tungsten filament in the modern electric light saves two millions of dollars a day in current.

Behind that saving lies one of the most romantic stories of scientific research which can be imagined. The romance finds its roots in the fact that tungsten is naturally the most intractable of all metals, as for certain purposes it is the most useful. Almost it seems as if Nature defied the scientist and the laboratory to win it for man's use. Not only has it a higher melting point than any other substance (save only carbon), so that it cannot be melted or cast (since anything containing tungsten to be melted would melt before the tungsten), but the metal when produced as such in any other form than a fine powder exhibits characteristics of hardness and brittleness which defy the hammer, the lathe and the die.

Yet today we possess ductile tungsten. We make fine drawn wires of it; we make little disks of it which serve as contact points in our automobile ignition system; our modern X-ray tubes depend upon it.

Given a few ounces of finely powdered metallic tungsten, which cannot be melted in anything because "anything" will melt at a lower temperature than tungsten, how shall one make of it a solid metallic rod? Given a solid metallic rod of tungsten which will break if dropped upon the floor like so much glass, how shall one shape it, work it, draw it into wire?

That was the problem which Dr. W. D. Coolidge undertook to solve with the help of the great electrical laboratories at Schenectady and the resources of men, money and facilities freely provided for the search, because of the enormous commercial importance of the production of tungsten filaments for electric lamps, *which would not break.*

It would take pages, where here are available but paragraphs, to describe the long series of experiments which led to the final success, or more than to indicate the discouragements. The worst of the matter was that there was no knowledge in the beginning that search was not being conducted for something which didn't exist—every shred of evidence available seemed to point to the fact that tungsten was not naturally and never could be made ductile, that the hunt was a hunt for the non-existent.

But Dr. Coolidge had persistency and faith, with a firm belief that if there were no direct way there might be an indirect way; and through indirect ways he worked until he produced the finished article—ductile tungsten, now available, in wire and in rod, in block and in sheet for the purpose which only a metal of such a high melting point (3,000 degrees Centigrade) can serve.

The metal, in the form of a powder, produced by treating the oxide (obtained by chemical means from the tungstate of iron and manganese or from the tungstate of calcium, both of which occur in nature) with heat and hydrogen, is pressed in a mold to form a slender square rod. In this condition it can no more be picked up than can a slender square rod of wet sand. But like wet sand, it can be slid upon a slab, and if that slab be of molybdenum (a metal of the same family as tungsten and with a high melting point of its own) the whole can be inserted into an electric furnace and in an atmosphere of hydrogen raised to a white heat. Kept at this temperature for a sufficient length of time, the individual grains of the metal, while they do not melt, do draw together and become a semi-sintered body. Whether they weld or adhere each to each by surfaces only, makes no difference. The rod, slightly shrunk, can now be handled, though it is yet more brittle than glass and can no more be drawn or hammered than a stone.

The next process is to grip its ends in copper jaws, one pair a fixture at the top of a hydrogen container, the other floating in mercury at the bottom. Through the rod is now passed a current of electricity which heats it again, this time to a temperature just short of the melting point of the metal. The copper jaws at the upper end and the mercury at the lower are water-cooled to keep them from melting, but the rod between is white hot with a heat beyond any otherwise applied to any metal.

*THE story of Dr. Coolidge adds a new angle to the Romance of Invention—the romance of a man who is hired by a great corporation for the single purpose of inventing things, and who proceeds with marvelous facility to invent things that might well have seemed impossible. Indeed Dr. Coolidge himself emphasizes the fact that the great success which he has had in his work with tungsten and its applications is to be attributed not alone to any genius and persistence which it may be his good fortune to possess, but equally to the fact that he is backed by the resources of one of the greatest commercial organizations in the world. And certain it is that many an invention which has not been brought to perfection would have flourished and borne fruit had the prospective inventor been assured of a comfortable salary, competent assistance in every collateral issue, and unlimited financing of such steps in his work as might be beyond the means of a private investigator. The story of tungsten tells us that among all the things that are intrinsically possible, there is nothing that syndicated invention may not hope to conquer.*—THE EDITOR.

When the rod comes from this treatment it has shortened materially. Its particles have shrunk together, coalesced—it has become a solid piece of metal. And now if the original powder was neither too coarse nor too fine and the heat treatment has been just right, the rod will permit itself to be hammered—a little—at a high temperature. This hammering must be very delicately done—a blow too hard and the white hot rod breaks, never thereafter to be satisfactorily welded by any process known to man. In practice the "hammering" is called "swaging" and consists of repeated blows of pairs of successive dies, each pair slightly smaller than its predecessor. A special swaging machine was devised expressly for this work, which regulates the blow to the exact weight necessary, and gives new shape to the rod by gradual steps.

Smaller and smaller gets the rod, and with each hammering, each heating and each decrease in size, it gets more and more tractable, until, when reduced to the size of the lead in a pencil it is in a condition where at last it may be drawn, hot, through diamond dies, and come out the other side in the form of a fine wire, strong as steel and almost as flexible as copper.

There were tungsten filaments before ductile tungsten—processes of mixing the powder with an amalgam or some other binder and distilling out this binder from wire formed from the mixture, resulted in true tungsten wire, but wire which broke with a jar and shattered with a blow. Electric lamps made of such wire were resistive to the heat developed but could no more be applied; for instance, to automobile headlights than glass could be used to make baseball bats. Not until tungsten was made ductile, not until the investigation and research under Dr. Coolidge demonstrated that what the life history of the tungsten group of metals seemed to say did not exist wanted only enthusiasm, determination and time for its complete discovery, did the modern tungsten-filament lamp become a possibility.

The American Academy of Arts and Sciences gave Dr. Coolidge the Rumford Medal for his work in producing ductile tungsten. Not one man in a million, perhaps, who reads by a tungsten light, who sees an electric sign or runs an automobile having an ignition system dependent for its operation on a little pair of tungsten contact points, or who has an X-ray picture made of what ails him with a tube that is efficient and powerful because it has a tungsten target at one end and a hot tungsten cathode at the other, knows the name of the young man with the happy smile and the enthusiastic devotion to this work which has so greatly benefited the world. The scientific world knows, however, and the SCIENTIFIC AMERICAN section of the great American public is now told—Coolidge is the man who did it.

The search for ductile tungsten was conducted with the idea that it was the solution of the great industrial problem—the production of economical and efficient electric lights, possessing long life and ability to keep their candlepower well up during long use. But many other uses have been found for ductile tungsten, of which by no means the least important is its employment as the "target" or anode in an X-ray tube.

The X-ray tube is so much a special tool, confined almost exclusively to the physicians and the sick room, that those without broken bones or foreign bodies intruded into their living machines, or who fail to provide work for doctors by getting pneumonia or cancer or some other diseases which may be either investigated or treated with the strange light rays which pierce ordinary tissues almost as easily as sunlight does glass, know little about it. In the light of Dr. Coolidge's work with the tube, it may even be said that the scientific world didn't know much about it until he took hold of it and developed the hot cathode tube.

Prior to that time, a certain minimum amount of gas in the tube was essential to carry the current across the gap between anode and cathode. In the Coolidge tube the cathode is formed of a tiny spiral of tungsten wire which is heated by a current of electricity. When sufficiently hot, it emits electrons which carry the current impressed upon the terminals across the gasless gap between. Exhaustion of gas in the Coolidge tube is carried to as high a point as modern vacuum production can attain, with the result that puncturing troubles disappear, the focal spot no longer moves, and local heating of the glass is conspicuous by its absence. Moreover the intensity of the X-rays produced is easily and directly controlled by the amount of heating permitted in the hot cathode. High or low penetration may be obtained at will from the same tube, and, equally as important, one operator may exactly duplicate the conditions under

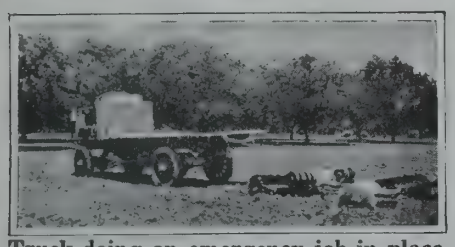
(*Continued on page 292*)

**Dr. W. D. Coolidge, whose invention makes tungsten workable, revolutionizes the lighting industry and makes the X-ray an instrument of precision**

# The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

*This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles*



**Truck doing an emergency job in place of a disabled tractor**

## Motor Truck as Tractor

THE motor truck is constantly proving its versatility and adaptability to all kinds of work on the farm. Not only is its usefulness increasing for delivery work on and about the farm but it has also demonstrated that it can work in uncultivated fields in case of an emergency. This is the discovery of William Berkenstock of Fullerton, California, who used a three-ton, four-wheel-drive truck to disk and sub-soil a ten-acre orchard, in which he was preparing to plant young citrus trees. When his tractor broke down and he was confronted with the task of disking the field before the trees arrived he hooked the disk on to the truck and dragged the entire tract with ease. While this is unusual work for a truck it demonstrates, nevertheless, its versatility and power in emergency cases and also brought out the tractive power of the four-wheel-drive principle in an unmistakable manner.

## Delivering Coal for $1 Per Ton

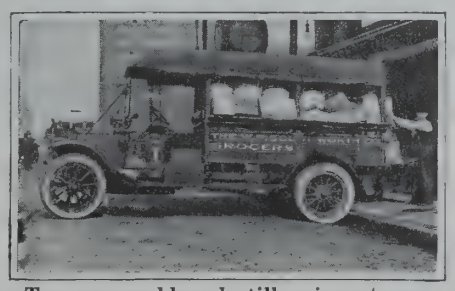
THE big advantage of a motor truck in the coal business is that it brings the outlying sections of the city closer to the coal yards. A prominent firm of retail coal dealers of Brooklyn, New York, use a truck for delivering coal to residences, factories, stores and office buildings, most deliveries being to retail trade. This delivery has heretofore been considered most economical by teams, however, including all items of expense, the motor truck has been delivering coal for $1.00 a ton.

The motor truck actually covers twice the radius of a team, and does the total work of 2½ teams. For instance, during one month recently, this machine made 91 trips, traveled 684 miles, and delivered 526½ tons of coal. In the same month the teams averaged but 325 tons. This average shows that the motor truck delivered 61 2/3 per cent more coal in spite of the fact that this tonnage was hauled twice as far as the horses traveled.

These motor trucks are loaded from overhead hoppers, and a 6-ton machine can be filled in seven minutes. Every morning the motor trucks are weighed to give the actual empty weight each day to subtract from loaded weight. This empty weight varies from time to time and the variation must be taken account of in order to give customers exact weight. The accompanying illustrations show how trucks can be used advantageously in coal hauling. One shows the hopper loading system that cuts down delivery costs, the other shows light trucks hauling lump coal.

## Veteran Truck in Grocery Service

A PROMINENT truck company frequently has said in its advertising that the useful life of its product has not yet been determined and this statement seems to be borne out by the performance of Truck "A," dean of the delivery fleet of a Cleveland house, which has entered upon its tenth year of daily service and bids fair to emulate the example of Mr. Tennyson's well-known brook and run on forever. While not the oldest truck of its make



**Ten years old and still going strong**

in operation today, a number of trucks antedating it in delivery, Truck "A" is unquestionably the veteran to remain continuously in the service of its original owner. It was in May, 1910, that this two-ton truck was delivered to the purchasers by the maker and immediately put into commission in charge of a driver who was a lover of fine machinery and at once made the truck his pride. So carefully did he care for the truck and so carefully was it driven, that in a little more than nine years but one slight mishap marred the record of truck and driver, though all of the work was performed in the midst of constantly increasing traffic perils in the growing city of Cleveland—a wonderful record which, unfortunately was ended by the death of the veteran driver a few weeks ago.

Originally the truck was used to transport goods between the company's three stores in Cleveland, in general hauling from the depots, and in delivery service. When it was four and a half years of age, the owners estimated from the records kept that the truck had then covered 200,000 miles. Since that time a portion of the burden once borne by Truck "A" has been transferred to heavier trucks which have been added to the fleet, but it has easily added an additional 100,000 miles to its record and is today, according to the superintendent of delivery for the company, "in good shape and doing about forty-five miles per day."

This bears out the contention that has been made from time to time in these columns by the writer that more trucks are worn out by abuse than by use.

## Horses Displaced by Tractors

THE number of horses displaced by tractors in the corn belt is largely determined by the number it is necessary to keep for corn cultivation and other work current at the same time which the tractor cannot do. This is perhaps the most important of the facts brought out by an investigation recently made by the United States Department of Agriculture in seven corn belt states, relative to the influence of tractors on the use of horses, the results of which have been published in Farmers' Bulletin 1093.

The Department has drawn on the experience of 191 tractor owners in the preparation of this bulletin, which is designed to enable the corn belt farmer to answer for himself the following questions:

For what operations can I use the tractor?

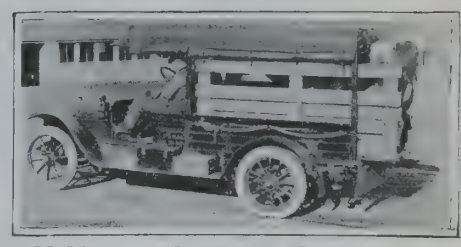
In what operations will it displace horses in whole or in part?

How many horses will it displace on my farm?

It was found that the number of horses disposed of by the farmers in question after buying tractors was between two and three a farm. The average number of acres tillable by horses was increased 12 and the average size of the farms by a total of 22 acres. Several operators displaced horses entirely on plowing, disking and harrowing. Few operators allowed their horses to stand idle while the tractor was in use.

The tractors were used for an average of 29 10-hour days a year on the home farms, no records being taken of custom work. A three-plow tractor on these farms does the work of 8½ horses in plowing, disking, harrowing and harvesting.

The results of this study further substantiate the conclusion that the principal advantage of a tractor lies in its ability to do heavy work in a shorter time than is possible with horses.



**Making good use of the truck in handling live stock**

## Small Packers Aided by Trucks

IT is due to the successful operation of the motor truck as a live stock carrier that small packing centers are being established in different parts of the country. Packing centers shorten the haul to market as the products do not have to be hauled to distributing centers before being sent out to the ultimate market. This in turn has an important bearing on keeping the cost of meat down to a minimum. The live-stock grower instead of loading stock in cattle cars to ship to the different centers now hauls it to the nearest packing center in his motor truck, saving time and expense as well as delivering cattle and hogs in the same condition they left the farm. The consumer in the vicinities of these packing centers is able to get fresh meat at a price lower than if the meat had come a great distance. Thus it can be seen that the benefits of the motor truck are not just those that are directly attributed to it, but are benefits that redound in a greater area than is realized.

The accompanying illustration depicts one practical method of transporting live stock by small motor truck. The animal is carried in a special rack or crate that fits inside the main body and which can be loaded or removed without disturbing the live stock the truck is to carry. This simplifies handling the animals, especially when small and active, as sheep or swine are, and also protects the truck body from the filth inevitable in transporting live animals for any distance.

## Motor Trucks Help Small Towns

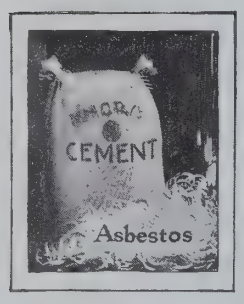
MANY a small town which for years has appeared to be doomed to oblivion because it was not lucky enough to get on a railroad line is being put on the map today, and the motor truck gets the credit. This new mode of transportation opens up markets both ways, making it possible for residents of these communities to ship their products at low cost to neighboring cities, and also brings to them the goods of the outside world, thus permitting a growth in population that would otherwise be impossible, especially in newly developed oil and mining districts.

***Left:*** **Rapid and economical delivery of the coal to the truck from the railroad.** ***Right:*** **The largest sizes of coal are economically handled by big trucks.**

**The part played by the motor truck in cutting down the costs of the coal business**

Residence of Henry F. Keil, Rye, N. Y., Henri Vallet, Architect

# Shingles of Asbestos beautiful, fireproof and economical




*Asbestos Shingles should not be confused with asphalt or other so-called composition shingles manufactured to meet the demand for low-priced roofing material in the face of rising costs. Asbestos shingles have earned from the Fire Underwriters' Laboratories the high rating of Class A.*

TWO considerations seem to be the basis of everyone's choice of a home roofing material—appearance and durability. And both are important.

Charm in a home roof is as necessary in its way as dependability and durability, for many good-to-look-at roofings fall far short of what might be called a perfect housetop specification. Tile, for instance, is heavy and costly; slate, if not expensive, is heavy and has certain limitations in color and weathering properties.

Even the wood shingle (the traditional house roof of America) is now challenged by the beauty of Johns-Manville Asbestos Shingles which are fireproof, and hence satisfy fully the fire authorites of the more than 114 cities that have prohibited the use of inflammable roofs.

Here, then, in asbestos shingles, we find the one roofing material that combines *all* the qualities that a perfect roofing should have.

Permanently durable and fireproof because they are actually made of rock (asbestos mineral fibre and Portland Cement) nothing organic in their composition to rot, warp or disintegrate under varied weather conditions.

Supremely artistic in their appearance, with all the soft tone values and weathering properties so lacking in other mineral roofs.

No wonder that both architects and house owners are pressing our factories to utmost capacity.

Johns-Manville Asbestos Shingles are easily laid in either the American or Hexagonal method of arrangement and in gray, brown, red or in the beautiful Colorblende assortment—the aristocrat of all roof coverings

*Throw a Johns-Manville Asbestos Shingle into a red-hot furnace. It will not burn.*

JOHNS-MANVILLE CO.,
Madison Ave., at 41st St., New York City
*10 Factories—Branches in 64 Large Cities*
For Canada:
CANADIAN JOHNS-MANVILLE CO., Ltd.
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JOHNS-MANVILLE SERVICE
COVERS THIS CONTINENT

*Through—*

**Asbestos**
and its allied products

INSULATION
*that keeps the heat where it belongs*
CEMENTS
*that make boiler walls leak-proof*
ROOFINGS
*that cut down fire risks*
PACKINGS
*that save power waste*
LININGS
*that make brakes safe*
FIRE PREVENTION PRODUCTS

# JOHNS-MANVILLE
## Serves in Conservation


## Shall the Corn Field Run Our Cars?

*(Continued from page 274)*

In Germany nearly 70 per cent of the annual output of more than 100,000,000 gallons of alcohol is got from potatoes. In France, on the other hand, the chief source of industrial alcohol has been the molasses from the beet sugar refineries. Both of these basic raw materials are to be had in the United States in abundance, especially potatoes of the kind known to the farmer as seconds and culls, for which there is only a limited market. Potatoes that are unfit for food, because diseased or touched by frost, can be utilized in the manufacture of alcohol. A ton of the tubers, if they contain 16 per cent of starch, will yield 25 gallons of alcohol. Many millions of tons of potatoes are sacrificed yearly which could thus be profitably consumed in the distillation of motive spirits.

But probably the most promising native source of industrial alcohol is our vast corn belt; maize for years has stood pre-eminently as the cheapest raw stuff for the distillers. It is easy to raise, and stands transportation and storage admirably. It is undeniably true that wood waste is susceptible of furnishing a great volume of industrial alcohol, but there are difficulties of an outstanding nature which now seriously hamper putting any of the processes in service upon a commercial scale of moment. Similarly, recent developments in the field of chemistry have shown that it is entirely practicable to get a goodly measure of alcohol from the waste liquor of the mills engaged in the making of sulfite paper stock. The Germans are said to obtain quite 3,000,000 gallons of spirits from this origin annually; and the Swedes are employing a kindred method at thirteen of their sulfite mills—10,500,000 gallons of 100-per-cent-pure alcohol are thus realized in the course of a twelvemonth.

But alcohol in quantity enough for industrial and motive purposes is not to be had from by-product materials. We shall have to count upon an ample primary substance which can be cultivated for that purpose season after season. Here is where corn meets every requirement. It can be planted and harvested within ninety days throughout an enormous area; and a ton of the grain should yield about 89¼ gallons of pure alcohol. A large distillery should be able to handle 10,000 bushels of corn a day, and do this 300 days a year. That is to say, a plant of this size would have an annual output of 7,500,000 gallons.

In 1919 we grew 2,900,000,000 bushels of corn, representing a possible source of 7,250,000,000 gallons of alcohol. As a matter of fact, during the past year, our gasoline consumption amounted substantially to 3,100,000,000 gallons. Manifestly, then, if one-fourth of our corn had gone to the distillers of industrial alcohol we should have been in a position to get enough motive spirits to cut down the use of gasoline by fully 58.4 per cent. And if alcohol were used as the basis of a synthetic fuel such as those already mentioned, the mixture with ether, toluol, and benzol would effect a gasoline economy of quite 70 per cent in one case and 100 per cent that with ether alone.

The point to be kept in mind is that our farmers have it within their power tremendously to amplify the acreage planted in corn; and it has been suggested by the agricultural authorities that it would be possible to secure a still greater yield of alcohol if cornstalks were utilized. But this theoretical source of more motor spirits need not be considered because there are practical difficulties that stand in the way of putting laboratory revelations along this line to commercial use. Success in the manufacture of industrial alcohol rests fundamentally upon a sufficient and a continuous supply of the primary raw material, and, because of its keeping qualities, corn can be harvested and then held in storage where it can be drawn upon months thereafter. In this respect it is unlike a number of other potential vegetable sources of alcohol which can be turned to account for this purpose only during a comparatively short season.

Without going into the details of the making of alcohol from farm products, it will suffice to say that the first object is to convert the starchy content of potatoes, corn, etc., into sugar through the agency of fermentation; and as a further result of the action of the yeast the sugar is split up into alcohol and carbonic acid gas. Subsequent continued distillation separates the alcohol from the water with which it is combined, adding step by step to the strength or purity of the spirits.

According to present practice, little if any of the carbonic acid gas is saved from the fermenting mash, and right here exists a means of greatly lessening the cost of alcohol. A bushel of grain during treatment will give off seven pounds of $CO_2$. This gas has a ready market in the charging of bottled waters, beverages, etc., and for use at soda fountains. In fact, the present demand is far in excess of the supply. The $CO_2$ liberated during fermentation is in its purest state and is superior to that made from marble dust, which has to be very carefully filtered, etc., to render it salable. Carbonic acid gas figures in refrigerating systems, and its fields of application are wide and varied. With a proper installation there is apparently no reason why this money-making by-product of the distilleries should not be conserved.

Lest there be a mistaken notion that a foodstuff as such is lost in the manufacture of alcohol from corn, it should be kept in mind that there is a fibrous residue or "slop" which contains 12 per cent of fatty matter and 33 per cent of protein. This, when dried in drums, looks not unlike middlings, and constitutes an excellent feed for hogs, cattle and chickens. The thin slop may, however, be fed to livestock by mixing it with roughage or by adding a proportion of the "middlings." This brings us to the story of a new fuel, which is rapidly growing in favor and finding many serviceable applications.

## Putting the Payroll on an Automatic Basis

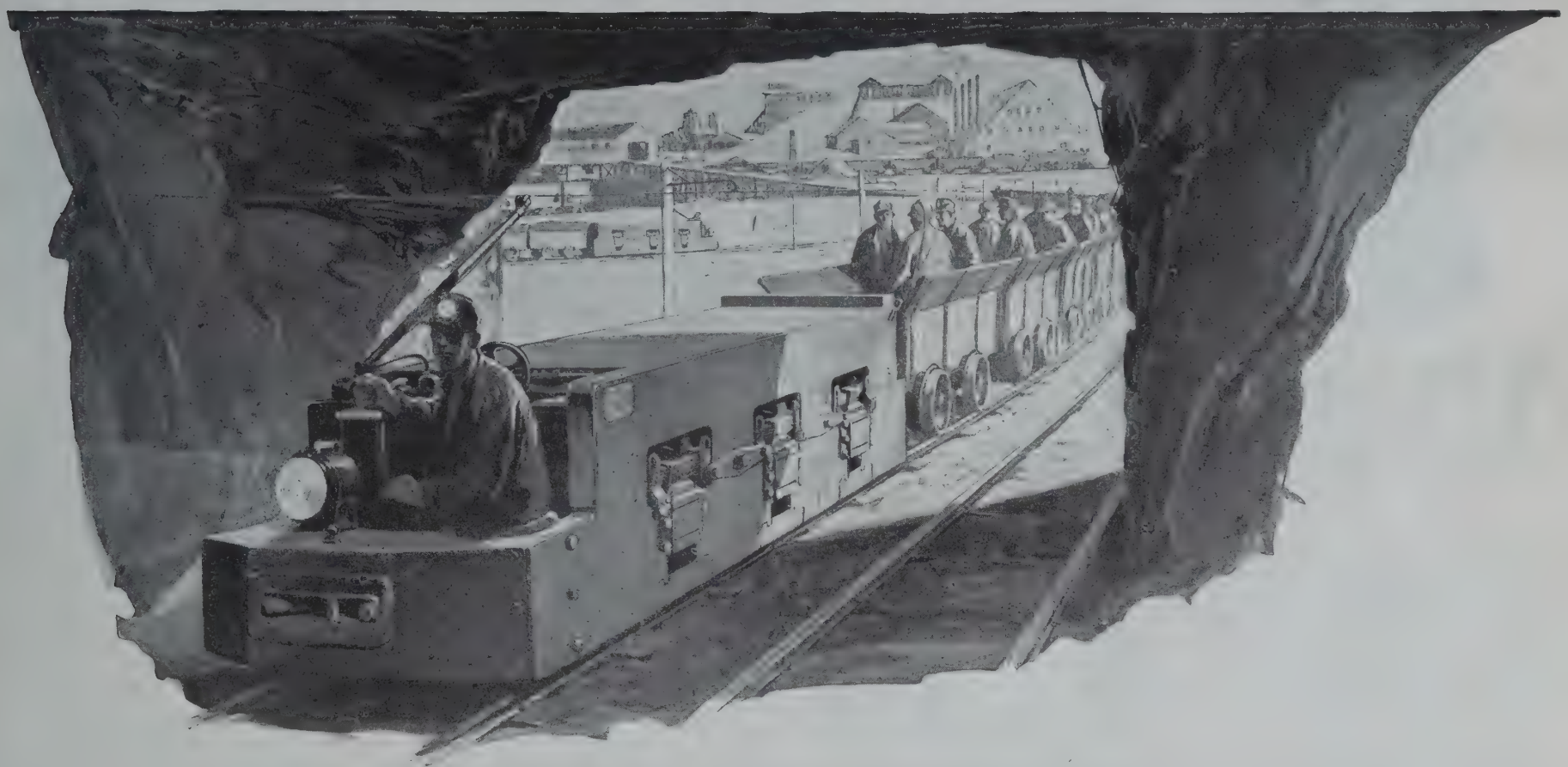
*(Continued from page 275)*

printed record of the amount put into each envelope. In using paper money instead of gold coin the procedure is slightly different but the results are identical. The payroll is thereby apportioned in a fraction of the time otherwise necessary and there is a printed record of the total amount put into each envelope. This record is perhaps the most important individual feature of the machine.

Under the old system, if an employe claimed that his pay was short it was practically impossible to check his claim once he had opened his envelope. Even though the cash had balanced after making out the payroll it was possible that some other employe might have been overpaid a similar amount. With the International payroll machine all such claims can be readily adjusted because the paymaster knows from his printed record exactly how much was put in each envelope. Even if the operator should make a double error, it will appear in the printed record. The machine thereby protects the employe against possible clerical errors and at the same time protects the employer against the claims of dishonest, careless, or mistaken employes.

When not required for payroll work, the machine can be used for adding and other computation in the same way as other visible adding and listing machines are used. This in no way interferes with the payroll mechanism which is connected or disconnected at the pressure of a key.

*In the basic industries of this country, without which other industries could not exist, electricity is the dominant factor in rapid and economical development*



# The "Black Diamond" Miner's Best Helper

WHEN a coal miner clamps on his electric headlight, jumps aboard an "empty" and rolls smoothly along the "motor road" into the mine, his electric day has only begun.

Down in the mine, an electric spark ignites the blasting charge which tears away rock and opens the vein—an electric drill helps him cut his coal. While he works, electric light brightens all operation — electric pumps draw flood water from his path—electric fans supply him with fresh air, increasing his efficiency and protecting him from dangerous smoke and gases.

Small electric locomotives pull cars of coal to the main thoroughfares of the mine, where they are made up into heavier trains and hauled to the tipple by more powerful electric locomotives. There a huge electric hoist lifts cars bodily and dumps the coal into the breaker to be crushed and screened into various sizes by electric motor-driven machines—and later dropped into railroad car or ship by the same operator throwing another switch on the electric control panel.

These manifold phases—necessary to the successful electrification of the mining industry — were broadly encompassed by the accumulated resources and engineering initiative of the General Electric Company.

Such service and facilities are at the disposal of all industry.

General Electric Company

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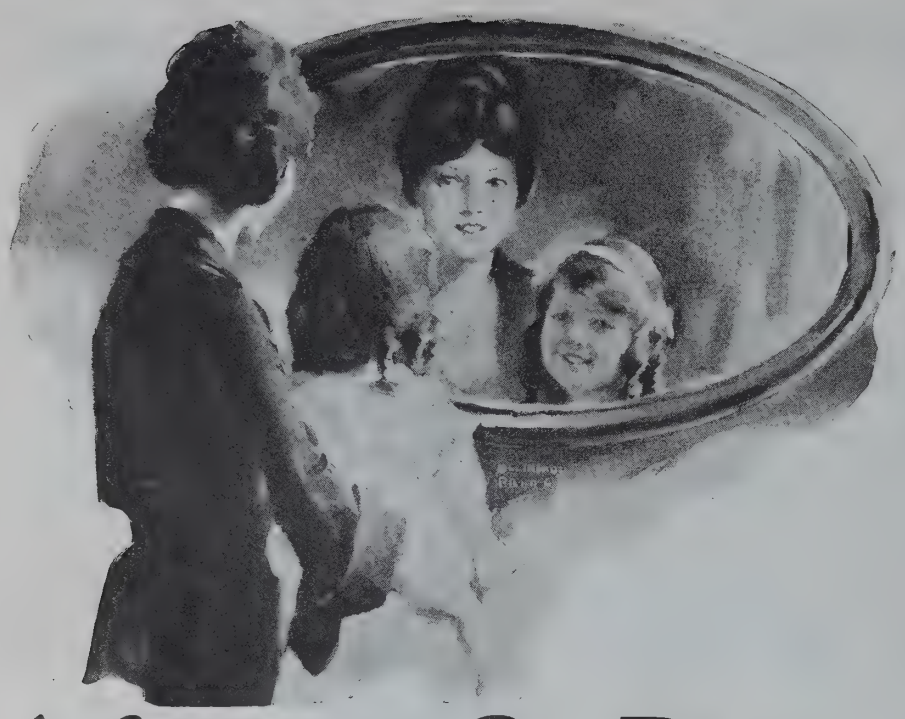

# After 10 Days

## See what this new way does for teeth

*All statements approved by authorities*

There is a new way of teeth cleaning which millions now employ. Leading dentists everywhere advise it.

You can see the results wherever you look—teeth that glisten as they never did before.

This is to offer a ten-day test. Then to urge that you let your mirror show how much it means to you and yours.

### Fights the film

The object is to fight the film which causes most tooth troubles.

That viscous film you feel on teeth is their great enemy. It clings to teeth, enters crevices and stays. Then it dims the teeth, and night and day it may do ceaseless damage.

---

It is the film-coat that discolors, not the teeth. Film is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Very few people escape these troubles which are caused by film.

### What ruins teeth

Much of this film remains on teeth under ordinary brushing methods. Many tooth pastes even favor the film. Thus millions find that well-brushed teeth discolor and decay.

The reason lies in film, and dental science has for years been seeking a way to combat it.

The way has now been found. It has been proved by decisive clinical and laboratory tests. Its efficiency is beyond question. And this method has brought to millions a new era in teeth cleaning.

The methods are all embodied in a dentifrice called Pepsodent—a dainty tooth paste which complies with every modern requirement. That is the product we ask you to test in your home.

### Acts in numerous ways

One ingredient of Pepsodent is pepsin. Another multiplies the starch digestant in the saliva to digest starch deposits that cling.

Another result is to multiply the alkalinity of the saliva to neutralize mouth acids, the cause of decay.

Two factors directly attack the film. One of them keeps the teeth so highly polished that film cannot easily cling.

Thus in several ways, new and efficient, Pepsodent combats the teeth's great enemies. It brings essential results which Nature intended, and which old methods failed to accomplish.

### The way to know

Ask for a 10-Day Tube. Watch the results, then read the reasons for them in the book we send.

Those whiter, cleaner teeth you see mean safer teeth. They mean that film, great tooth wrecker, is being day by day combated.

Compare the results with old methods. Then judge how much this new way means to you and yours. Cut out the coupon now.

**Pepsodent** PAT. OFF. REG. U.S.

*The new-day dentifrice*

**A scientific film combatant, now advised by leading dentists everywhere and supplied by all druggists**

461

**10-Day Tube Free**

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Only one tube to a family

**Watch the film go**

**Send this coupon for a 10-day tube. Note how clean the teeth feel after using. Mark the absence of the viscous film. See how the teeth whiten as the film coat disappears. It will be a revelation.**


## New Concepts of the Past Century

*(Continued from page 276)*

the results; and that whether or not his postulate ever be realized, the propositions that he deduces from it, being true, are of scientific interest. Actually, however, it is not quite as simple as all that. If it were sufficient to make a single postulate it *would* be as simple as all that; but it turns out that this is not sufficient any more than it is sufficient to have a single undefined term. We must have several postulates; and they must be such, as a whole, that a geometry flows out of them. The requirements are three.

In the first place, the system of postulates must be "categorical" or complete—there must be enough of them, and they must cover enough ground, for the support of a complete system of geometry. In practice the test for this is direct. If we got to a point in the building up of a geometry where we could not prove whether a certain thing was one way always, or always the other way, or sometimes one way and sometimes the other, we should conclude that we needed an additional postulate covering this ground directly or indirectly. And we should make that postulate—because it is precisely the things that we can't prove which, in practical work, we agree to assume.

In the second place, the system of postulates must be consistent—no one or more of them may lead, individually or collectively, to consequences that contradict the results of any other or others. If in the course of building up a geometry we find we have proved two propositions that deny one another, we search out the implied contradiction in our postulates and remedy it.

Finally, the postulates ought to be independent. It should not be possible to prove any one of them as a consequence of the others. If this property fails, the geometry does not fail with it; but it is seriously disfigured by the superfluity of assumptions, and one of them should be eliminated. If we are to assume *anything* unnecessarily, we may as well assume the whole geometry and be done with it.

The geometer's business then is to draw up a set of postulates. This he may do on any basis whatever. They may be suggested to him by the behavior of points, lines and planes, or by some other concrete phenomena; they may with equal propriety be the product of an inventive imagination. On proceeding to deduce their consequences, he will discover and remedy any lack of categoricity or consistence or independence which his original system of postulates may have lacked. In the end he will have so large a body of propositions without contradiction or failure that he will conclude the propriety of his postulates to have been established, and the geometry based on them to be a valid one.

### And What Is It All About?

Is this geometry ever realized? Strictly it is not the geometer's business to ask or answer this question. But research develops two viewpoints. There is always the man who indulges in the pursuit of facts for their sake alone, and equally the man who wants to see his new facts lead to something else. One great mathematician is quoted as enunciating a new theory of surpassing mathematical beauty with the climacteric remark "And, thank God, no one will ever be able to find any use for it!" An equally distinguished contemporary, on being interrogated concerning possible applications for one of his most abstruse theorems, replied that he knew no present use for it; but that long experience had made him confident that the mathematician would never develop any tool, however remote from immediate utility, for which the delvers in other fields would not presently find some use.

If we wish, however, we may inquire

*(Continued on page 288)*


# DURAND
## STEEL RACKS

WHAT is the nature of the commodity you handle?

Durand Steel Racks are equally adaptable to the storage of minute or bulky articles; small hardware, bars, billets, gears; dry goods or package supplies. They are scientifically designed to meet widely varying as well as fluctuating stocks.

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**No Filing**
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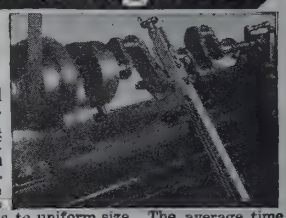
**No Jigs**

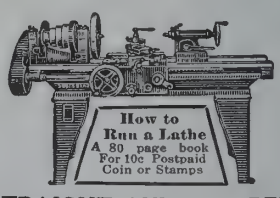


This Weber Tool turns all pins absolutely round from one setting of Crank Shaft, on centers. A micrometer dial enables the operator to gauge his cuts and turn all pins to uniform size. The average time required for trueing up one pin is from 5 to 10 minutes. The 4 pins can easily be finished in 30 minutes, and the entire shaft is completed with only one setting.

**The Weber Tool is guaranteed** to turn crank-pins within as close limits of accuracy as any other known method. It will soon save its cost in any Tractor or Automobile Repair Shop. An assortment of cutting tools are furnished. These will fit the pins of most of the popular automobiles, trucks and tractors. Write for Circular and Prices.

**SAWYER-WEBER TOOL MFG. CO.**
353 S. Alameda St. Los Angeles, Cal.

## SOUTH BEND LATHES

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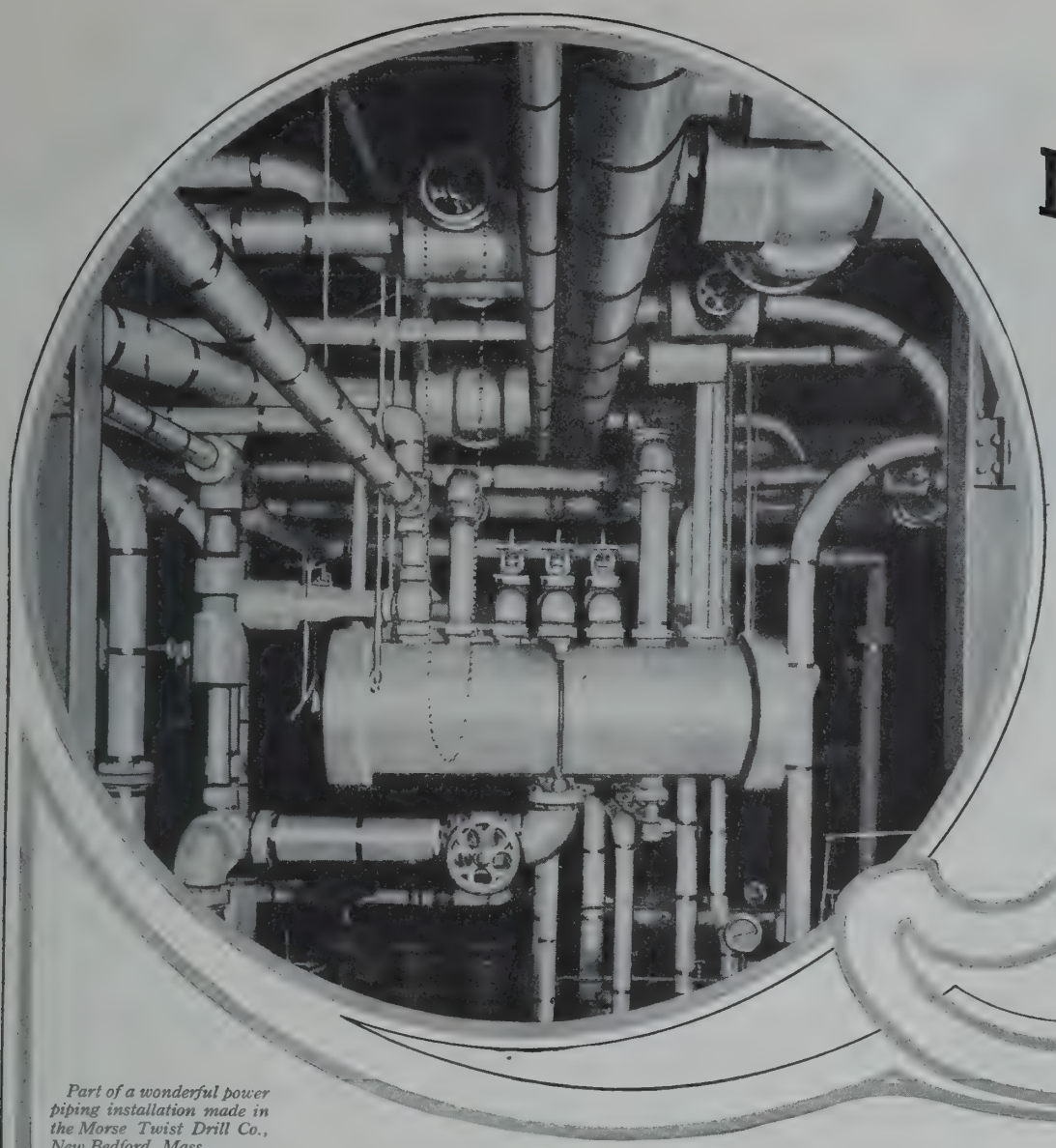

*Part of a wonderful power piping installation made in the Morse Twist Drill Co., New Bedford, Mass.*

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SCIENCE AND SERVICE

ASK YOUR CONSULTING ENGINEER

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Automatic Sprinkler Systems
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## Understanding

A BOY is learning to shoot an arrow from his bow. His father stands behind him, reaching down to steady the bow and with his own hand clasping the boy's fingers on the string. He draws the arrow to its head and releases it.

The boy acquires an understanding of the method, the *how* of this simple art. Their positions, one standing over and the other "standing under" illustrates why "understanding" is practical, *usable* knowledge. It is best gained in a practical lesson, standing and learning *under* a man who knows the *how*.

This process of teaching and learning has gone on decade after decade in the Grinnell Organization. Newer and better practices in designing and installing industrial piping equipments have been *understandingly* taken up by superintendents and foremen and passed down, in turn, by them to assistants and workmen.

That is how Grinnell Company for 70 years has been constantly making a part of itself all that is best in industrial piping practice. Such experience we believe is today embodied in our nation-wide organization for purchasing and testing materials and planning, fabricating and erecting them into industrial piping equipments of every sort.

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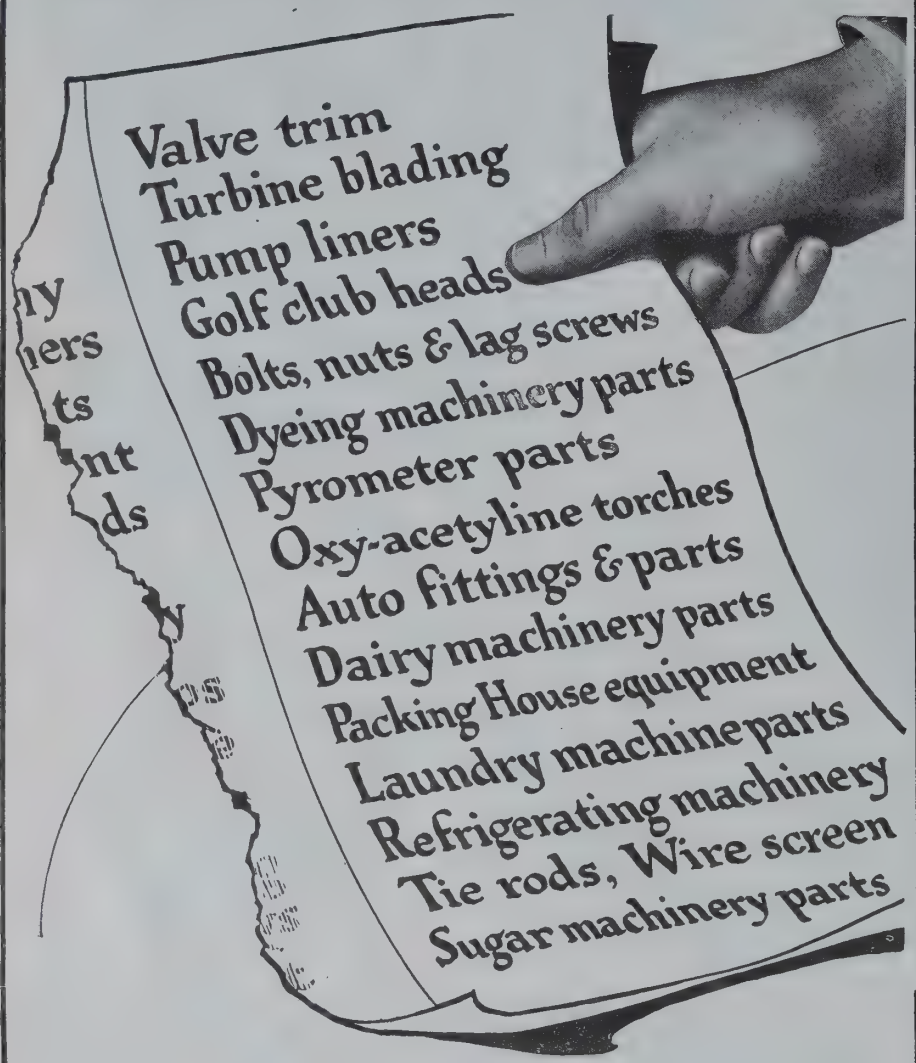
# The service is there when the metal delivers it




YOU pay for the design-time and labor that go to make a metal useful. Then rust, acid action, steam wear, salt pitting and high heats limit its service life and so discount your investment.

These corrosive forces have least effect on Monel metal. In fact such seasoned engineering organizations as J. G. White, Stone and Webster, Dwight Robinson Co., etc., have adopted Monel as standard for anti-corrosive service.

Monel valve seats and stems on 200lb. 125deg. F. superheat lines at the Sherman Creek station, United Electric Light and Power Co., New York, show no wear after six years' continuous service.

Monel shaft sleeves, impellers and runners on condensers and condenser pumps at the Cos Cob Plant of the N. Y. N. H. & H. R. R. have stood up for years against the corrosive action of polluted salt water.

Monel metal for thermo-couples, oxy-acetyline bodies and other heat exposed parts is giving an equally good account of itself in exacting service. (Its ratio of expansion is practically that of steel.)

In chemical process machinery, Monel is specified for filter cloth or for parts directly in contact with active solutions by the best informed consulting engineers.

THE INTERNATIONAL NICKEL COMPANY
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The International Nickel Company of Canada, Ltd., Toronto, Ontario

INCo Monel metal

The name Monel is given to a line of metal products produced by The International Nickel Company from a natural nickel alloy—67% nickel, 28% copper, and 5 % other metals. These products include Monel blocks, Monel rods, Monel castings, Monel wire, Monel strip stock, Monel sheets, etc. The name Monel indentifies the natural nickel alloy as produced by The International Nickel Company.

INCo MONEL METAL INCo NICKEL

THE INTERNATIONAL NICKEL COMPANY


## New Concepts of the Past Century

(*Continued from page 286*)

with perfect propriety, from the side lines, whether a given geometry is ever realized. We may learn that so far as has yet been discovered there are no elements for which all its postulates are verified, and that there is therefore no realization known. On the other hand, we may more likely find that many different sets of elements are such that the postulates can be interpreted as applying to them, and that we therefore have numerous realizations of the geometry. As a human being the geometer may be interested in all this, but as a geometer it really makes little difference to him.

When we look at space about us, we see it, for some reason grounded in the psychological history of the human race, as made up in the small of points, which go to make up lines, which in turn constitute planes. Or we can start at the other end and break space down first into planes, then into lines, finally into points. Our perceptions and conceptions of these points, lines and planes are very definite indeed; it seems indeed, as the Greeks thought, that certain things about them are self-evident. If we wish to take these self-evident properties of point, line and plane, and combine with them enough additional hair-splitting specifications to assure the modern geometer that we have really a categorical system of assumptions, we shall have the basis of a perfectly good system of geometry. This will be what we unavoidably think of as the absolute truth with regard to the space about us; but you mustn't say so in the presence of the geometer. It will also be what we call the Euclidean geometry. It has been satisfactory in the last degree, because not only space, but pretty much every other system of two or three elements bearing any relations to one another can be made, by employing as a means of interpretation the Descartean scheme of plotting, to fit into the framework of Euclidean geometry. But it is not the only thing in the world of conceptual possibilities, and it begins to appear that it may not even be the only thing in the world of cold hard fact that surrounds us. I had hoped to make clear in this place the reason for these statements and something of their significance; but after repeated boiling down I find that these introductory remarks occupy all the space that can be given to the subject in a single issue, so must postpone the conclusion of the matter till another date. This preliminary discussion will have fulfilled its mission if it has made the layman understand why Bertrand Russell, eminent mathematician, was able to say: "Mathematics is the science in which you never know what you are talking about, or whether what you say is true."

## Running the Gauntlet of Quality Production

(*Continued from page 278*)

sandth of an inch, the tolerance on the hardness is five points on the scleroscope, which is the closest test commercially practicable. Altogether, there are, on this single part, a total of 34 inspection operations, and since many of them must be repeated on each cam, the total number of inspection points is 140. On all the parts named there is one-hundred per cent inspection; that is, every one is inspected. On parts where such great accuracy is not required, the inspections are made on five or ten per cent of the parts, and unless trouble is discovered the balance are passed. Because of this fact, it is impossible to say exactly how many inspections of parts have been made for each car assembled. The number will be above 20,000 and below 25,000.

But if inspection of finished parts is necessary, we must not forget that the foundation of the quality of any product must be the materials that enter into it, and in its methods of selecting materials and handling them the American quantity production system has won a long advantage over the European hand-work system. These methods have now reached a point where nothing is left to chance, and where the exact properties of every piece of metal and of any other material are accurately calculated for the duty it is to do.

The automobile factory of this article purchases 18 fundamentally different kinds of steels, under 45 different sets of specifications, in order to meet the wide range of the needs of a single car. It uses, for the same purpose, seven different brasses, six different bronzes, and so on down the list, each material being chosen to fit a very definite function. Among the non-metallic goods it purchases leather, rubber, wood, glass, felt, fabric, asbestos, cork, gasket materials, bakelite and fibers. The inspection of these materials on their arrival at the plant is only the first step in the process of control.

Many of the materials undergo processes which produce fundamental changes during manufacture. The specifications for the steel alloys, for example, are so varied under heat treatment and carbonizing that it is possible for the factory experts to tell from a single particle of the finished material from which one of more than a hundred working parts it was broken. Finally the Materials Test Division has the added duty of determining from any returned or broken part whether there is any weakness due to manufacture, and recommending changes in specifications to meet it.

For these varied purposes the factory maintains an organization which centers in the laboratories with their expert scientists and elaborate testing machinery, and extends through a system of patrols to every corner of the factory. All materials are watched during processing and not allowed to wait for final inspection to reveal errors. They are constantly held to rigid specifications on all points that at all affect the duties they are to perform.

The testing begins before the purchase of any material, when samples are taken to the laboratories. In these the apparatus is elaborate, covering physical, chemical and microscopic examination. The chemical methods used are checked daily with samples of known content from the United States Bureau of Standards. The physical laboratory includes machinery for testing hardness, tensile machines capable of exerting 200,000 pounds force, torque machines which can exert above 600,000 inch-pounds, and impact machines. The microscopic laboratory is equipped to photograph enlargements of from 30 to 2,000 diameters.

Specifications for purchase of materials are drawn up after the tests on samples have been completed. After delivery of material no lot is permitted to go into manufacture till samples from it have also been tested. This is true whether the purchase is of raw, partly finished, or finished goods, and in the two last named classes of material the specifications have many times been so exacting, and so exactly enforced, that they have resulted in considerable improvements in the factories from which the purchases are made.

To illustrate, the control over a single piece—the ring gear—may be cited. When the steel arrives at the factory it is analyzed chemically for five different elements, which must be in exact proportions. Samples are then heat-treated and tested in the physical laboratories for tensile strength and elasticity. If these are correct, the steel is released, and goes to the forge shop.

There an inspector watches the temperature at which the forging is done. The forged blanks then go for a preliminary heat treatment, where the laboratory inspector checks the pyrometer. There are two heat treatments, then a test for hardness. After being machined the

(*Continued on page 290*)

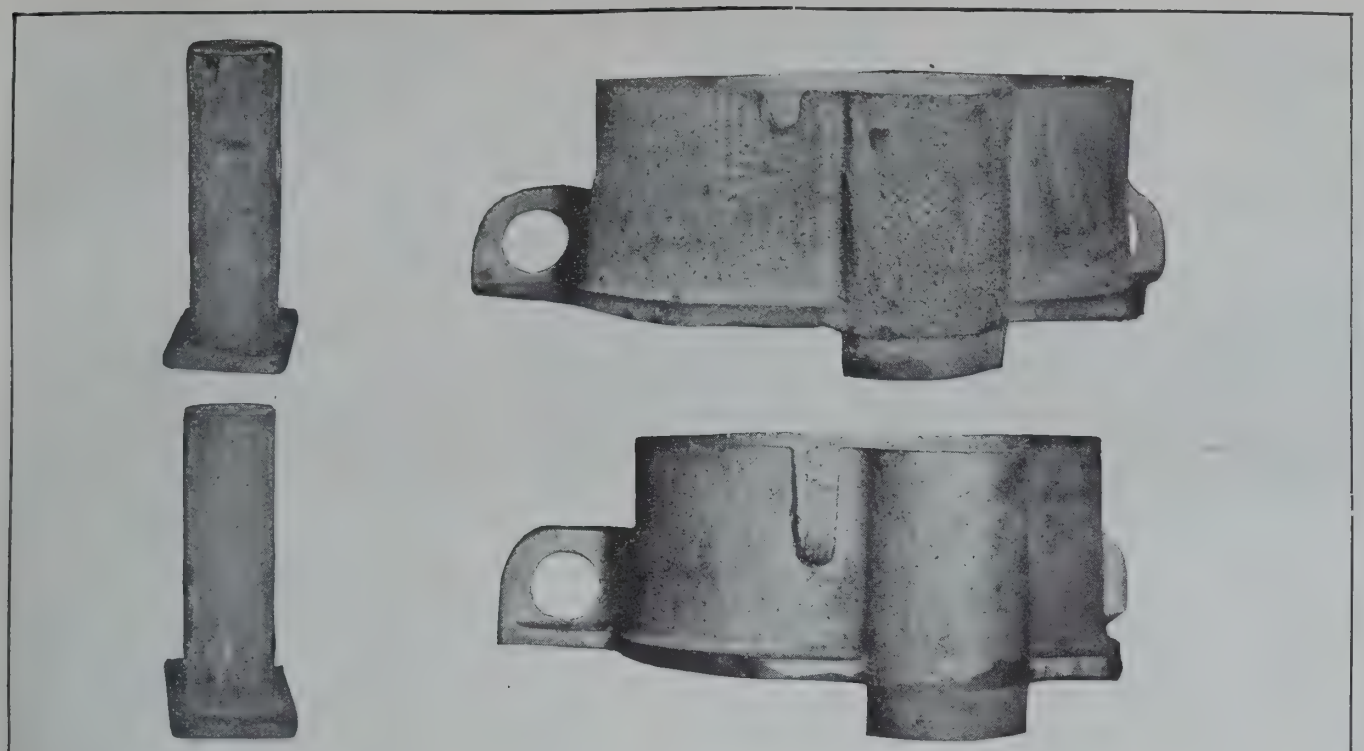


*Fig. 1—(Above) castings produced from hand-made moulds in comparison with (below) the same castings as produced by machine moulding.*

# Increasing the Use of Jigs Speeds Standardized Production

THE man who coined the phrase "doing it in jig-time" was a musician—not a machinist.

On the other hand, the machinist has put the idea to work at far greater profit than has his musical contemporary.

In point of fact the jig comes close to being the foundation of standardized large-scale production. Therefore, any precaution which either increases the applicability of jigs or reduces time in fitting castings to jigs is multiplied in later operations until it mounts into a saving of first importance. Scores of jobs which, in the practice now adopted in machine-shops, go to the layout tables could just as safely and far more profitably be jigged.

Just one condition determines whether the jig-work can be widely utilized in a machine-shop or whether the slower, more expensive layout process must be generally employed. It is a condition which is decided once for all before the machine shop becomes responsible for the progress of the work. It lies solely in the quality and *uniformity* of the casting. Neither adaptable machines nor skillful machinists can remedy the loss of time occasioned by poor castings.

Past foundry practice was built around a faulty understanding of human capacity which still persists in many foundries. The moulder is asked to perform operations demanding two utterly opposed abilities.

First comes the heavy work of shovelling sand and ramming it vigorously into the mould.

Immediately he is called upon to stop this heavy muscular labor and try to perform an operation as dainty as any required of a pianist or artist—he is compelled to attempt to draw the pattern accurately and steadily from the mould without causing the slightest flaw in the delicate sand surface, and without disturbing and breaking the thin walls and partitions of the sand by the slightest quiver of his muscles.

Obviously this method demands too much of any human muscles. The result is that after drawing a mould by hand there is immediate need for painstaking "slicking" and "patching" to repair defects in the mould-surface and delicate partitions. This, however, is merely an attempt but not a real remedy.

In the first place these repairs cannot be accurate because of the obvious inaccuracy of "free-hand" efforts. Secondly the slicked and patched spots in the sand are hardened more densely than other parts of the mould. The gases generated in pouring, instead of escaping freely and evenly at all points, are checked at those dense points, forming pockets of gas and treacherous "blow-holes" in the cast metal.

As a result, when the casting is machined three conditions show up: (1) the pad of finish metal is uneven, demanding extra cuts in many places and thus slowing down production; (2) the uneven texture of the metal is unnecessarily destructive of cutting-tools; (3) blow-holes or lack of alignment compel the scrapping of many castings even after the expenditure of much expensive machine work.

Out of all the centuries in which casting has been carried on it is only in the past fifteen years that the way to solve these obstacles has been found.

The modern cure goes directly to the root of these troubles—it successfully eliminates the uncontrollable variation in every muscular act by substituting machine-power at each step. Moulding machines replace human muscles.

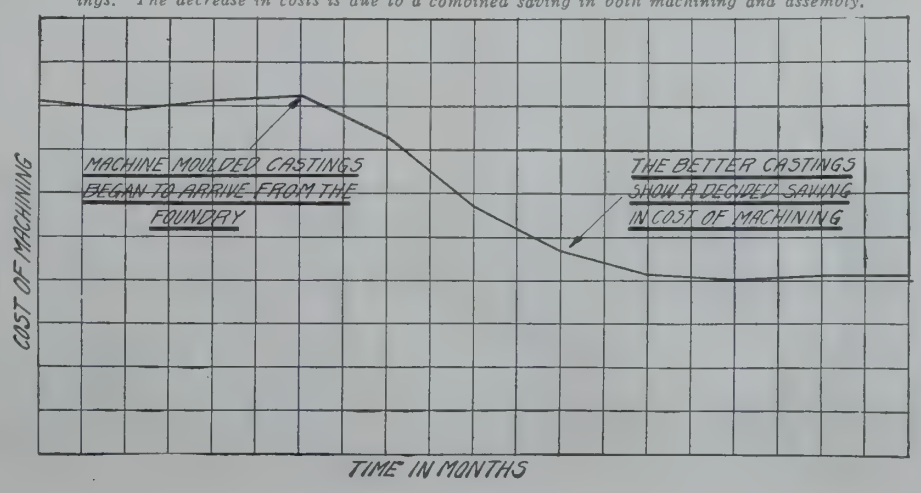
Machine-power rams the sand vigorously but evenly around and over the pattern. It jolts the sand to exactly correct density. It lifts and rolls the flask over smoothly. It draws the pattern without a quiver in true and vertical lift. The mould remains perfect with no need for slicking and patching.

This operation a machine repeats hour after hour through the day without variation. The moulds produced by machine during the fag-end of the shift do not deteriorate nor vary. The castings which come to the machine-shop from a careful machine-foundry are accurate to within $\frac{1}{64}$". This uniformity in size allows the casting to be jigged quickly—a very important and profitable feature. A small casting can be dropped into its jig and it will fit without any adjustment of the jig. A large casting will allow a jig to be placed on it—and again no adjustment of the jig is necessary. The expensive jig thus spends its entire time in useful machining rather than in wasteful adjustments. The uniformly-sized casting not only permits rapid jigging but also rapid machine work—both in the number of cuts to be taken on each surface and in the uniformity of cut. The temper-trying and costly discovery of a distorted casting—after a part of the machine work is done—is also eliminated.

These results are not limited to machining on any particular type of castings but are common to light, intermediate and heavy work.

The saving in maching costs, due solely to the elimination of human muscle in the previous casting operations, averages 17%, a figure reached by combining reports from machine shops operating on widely different types of work. The percentage of defective castings is reduced, on the average, 71%.

*Fig. 2—The graph below shows a typical result of a change from hand-made to machine-moulded castings. The decrease in costs is due to a combined saving in both machining and assembly.*



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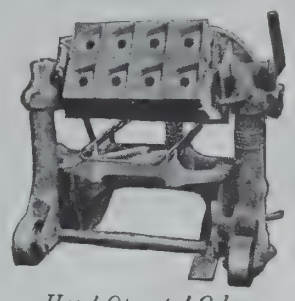

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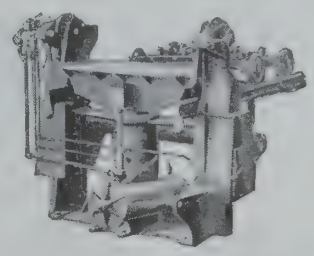

*An Osborn Roll-Over Model*

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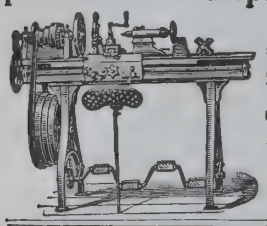

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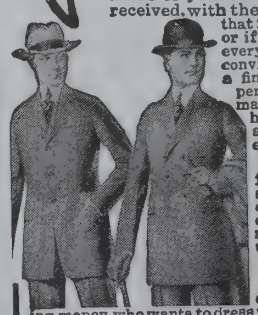

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## Running the Gauntlet of Quality Production

(*Continued from page 288*)

blank is returned for three more heat treatments, the pyrometers and process on each being carefully checked. Then there is a final test to make certain that the results are as they should be. So much for a single part. The process varies, of course, with each part. Similar watch is kept on all, as well as on the handling and mixing of brasses, bronzes and so forth.

The function of the laboratories does not end with the completion of the car. No product is perfect when first put out, and the labatories watch for "bugs." Whenever any part comes back as imperfect the laboratories gather it in. The microscope is the usual detective here, and it is possible to tell from the structure of the steel almost exactly what has happened to it.

Recently, for example, a front axle was returned with the complaint that it bent. Tests showed that it was soft, and a piece went to the microscope. This revealed an entirely different structure in the steel from that which was supposed to have left the factory, and indicated that the bar had been heated and hammered. With this clue it did not take long to learn that the owner of the car had been in an accident that bent his axle, had then had it straightened at a garage, and was now trying to get a new one on the false ground of imperfection.

But the principal work is of a different nature, and is illustrated on another axle—that for a truck. It was figured by the engineers that an elastic limit of 100,000 pounds for this piece would be ample, but several broke, and the limit was raised to 125,000 pounds, the laboratories specifying a different heat treatment. There was still breakage, and it proved impossible to get a higher strength with the steels available. So the company went into the market with a demand for a new steel and was able to get one that could stand 160,000 pounds. Still there was a little trouble, and under the microscope it was found that the weakness was in the steel itself. This resulted in the arrangement previously cited, under which the laboratories have full control of the heat-treatment. The specifications were changed, and were rigidly enforced, and the trouble disappeared.

A similar series of analysis was made with ball bearings. At first there was no standard, but exhaustive work finally led to the decision that the necessary quality could be secured by a heat-treatment which would produce the rare structure of spheroidal cementite. This has proved satisfactory, and the manufacturers of the ball bearings have improved their whole product to meet the specifications laid down.

In spite of all care imperfections creep in, and the whole series of tests is capped with two final inspections, one of the engine and at the very last one of the completed car itself. This last inspection is made by a department having no responsibility to the production department, and answerable only to the president of the company. It puts the car into operation and checks this on 34 different points, besides a general inspection for appearance.

## From Fish to Food

(*Continued from page 280*)

erable depth, and often in going from one side to another they would walk on the fish, causing considerable damage to those trod on. So the modern method is to place the fish into shallow boxes which are piled one on another so that the fish are brought into the cannery in perfect condition. Since most of the fishing boats operate within 20 or 25 miles of the canneries, it is merely an hour or two after being caught that they are delivered ready for canning, and they are processed immediately upon receipt at the


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cannery. The capacity of the sardine boats ranges from 4 to 10 tons, and practically all of them are operated by gasoline engines.

A novel method of locating sardine schools was tried out recently in southern California, and so successful did it prove that a definite scheme has been worked out by the fishing companies. The scheme is to use hydroplanes to skim close to the surface of the water and watch for the schools, and when discovered word is instantly sent to the waiting boats, which go to the locality of the fish. So far, the seaplanes used have been those attached to the Naval Air Station at San Diego, and as these machines are equipped with wireless outfits the aviators can keep in instant touch with their headquarters. When a seaplane sights a school of fish it wires back to the aviation field from where the information is telephoned to the Fish and Game Commission office at San Diego for distribution to the several canneries in the vicinity.

When the sardines are brought to the cannery, they are hoisted out of the fishing boats in large buckets, weighed and placed in large storage tanks until required for the cutting tables. Surrounding long work tables are large numbers of women who remove the heads and entrails of the fish. The bodies are then placed in large washing-vats, where they are thoroughly cleaned before being spread on flaking trays. These trays are either placed in the sun for the fish to dry or they are run through drying ovens. The tails are next removed and the bodies trimmed to the desired size.

The smaller fish are then fried in olive oil, drained, cooled and sent to the packing table. The larger fish are placed in cans which are inverted on trays and placed in steam vats where the fish are cooked and drained at the same time. The requisite amounts of olive oil and salt are then added, the cans sealed and heated in retorts, and later tested, labeled and packed in cases. To meet the different demands of the trade, the sardines are put up in a variety of sauces, including olive oil, cottonseed oil, tomato catsup, mustard and souse.

The broken bodies and the parts trimmed off in fitting the fish to the cans are made into sardine paste, and the waste parts are cooked, the oil pressed out and the residue made into chicken meal and fertilizer.

The waste in the sardine industry affords excellent material for the preparation of a high-grade fish meal. As it comes from the packing table it has been steam cooked and partially dried in the process of preparing the fish for packing, and can be taken after collection from the packing tables directly to a plant equipped for pressing and drying.

In an experimental plant maintained by the government it was found that from 27 to 33 per cent of meal could be obtained from the fish residue, and from raw materials containing from 12 to 17 per cent of oil, over one-half of the oil was removed by pressing. The oil obtained was bright, clear, and of very high quality. The fish meal from excessively fat fish contained 17.51 per cent of oil. After pressing and drying raw material which contained from 8 to 9.5 per cent oil, a dried meal was obtained containing from 9 to 12 per cent of fat. The meal obtained from this government experimental plant was sent to various points where it was used in feeding experiments with dairy cattle, poultry and pigs. The preliminary experiments conducted with dairy cows were sufficiently satisfactory to warrant a more extended study of the value of fish meal as a dairy feed, and this is now being conducted by the Dairy Division of the Department of Agriculture. The experiments with hens and and pigs were likewise satisfactory, and there will probably be a sufficient market to utilize all of the by-products from the sardine industry.

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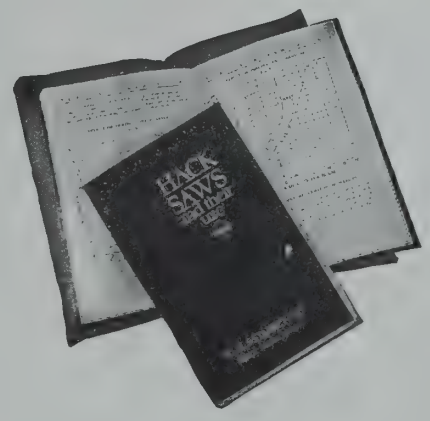


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## Using the Hand Hack Saw

Because a hack saw is so simple a tool, it is one of the most abused. Most of the waste in breakage, and most of the blame for inefficient cutting is due to the inexperience of the user rather than to lack of quality in the blade. Even a little instruction is thoroughly worth while in the interests of hack saw economy.

To quote from *Hack Saws and Their Use*, just published by The L. S. Starrett Company:

"In hand work, see first of all that the blade is well strained in the frame, with the rake of the teeth such that it will cut on the forward stroke. A flexible-back blade, because it lacks natural rigidity, should be strained tighter than an 'all-hard' saw. A properly strained blade, when 'thumbed,' gives a clear, humming note, which, once heard, is easily remembered. In using a flexible blade, the tension should be increased when cutting as the blade stretches while in use.

"If possible, lock the work securely in a vise. In cutting sheet metal, if the gage and size will permit, place the work in a vise so that a flat surface, rather than an edge, is in contact with the saw. If this is impracticable, put a light strip of wood on either side of the sheet of metal and cut through both the wood and metal at the same time.

"Always place the work in the vise so as to provide as great a bearing for the saw as possible. That is, set the work, if a piece of structural steel, channel or similar material, so as to engage the maximum number of teeth throughout the cut. When placing work in a vise, the tendency of coarse teeth to 'straddle' must be borne in mind, and also that the fewer the teeth engaged at any particular moment during the cut, the greater the strain on each tooth, and consequently the greater likelihood of stripping the blade.

"Start the cut slowly, using the same motion as in filing. Put on enough pressure to make the blade cut, and not slip or slide over the metal. Too little pressure in the first stages of a cut will take more out of a saw than fifty cuts made under proper conditions. By starting with a very light pressure, and allowing the saw to rub rather than cut the work, and then increasing the weight at a destructive rate once the first sharp edge is worn off the blade, it is possible to so completely ruin a saw that it will not make one full cut on a two-inch round. On the other hand, care must be taken not to use so much pressure that the teeth will engage the work too rapidly, or stripping of the blade may result. At the end of the forward cut, lift the blade slightly to avoid dragging or rubbing the teeth on the stock during the return stroke. Pressure during the return stroke is a frequent cause of premature loss of efficiency in hand hack saw blades.

"Generally speaking, hand hack saw blades should not travel faster than fifty strokes per minute; thirty-five or forty strokes are even better. Care must be exercised to avoid overheating the blade by too rapid cutting, and so drawing its temper. In hand sawing, it will generally be found worth while, after the first few strokes, to retighten the blade in the frame. This takes up any stretch that may have occurred, prevents drifting and tends to produce better cutting. When using flexible or 'soft-back' blades it is absolutely essential that the saw be retightened during use."—From *Hack Saws and Their Use*, published by The L. S. Starrett Company, Athol, Mass., for free distribution.

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This is a book the wireless experimenter cannot afford to be without. It enables one to design and construct their own apparatus This book will also prove of value to the layman.

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Another method for utilizing the by-products of the fish-canning industry is in the manufacture of commercial fertilizers. Fish scrap is rich in both nitrogen and bone phosphate, and as a fertilizer it is worth at least $40 per ton.

In the salmon canning industry it has been found that an average of 30 per cent of the fish that come to the factory is discarded as unsuited for canning. This includes heads, tails, fins, roe and viscera. This raw canning waste contains approximately 3.67 per cent of ammonia; 3.46 per cent of bone phosphate and about 10.43 per cent of fish oil. The waste products from the salmon industry alone would yield annually about 11,400 tons of fish scrap and about 2,500,000 gallons of oil. In addition to the salmon caught, large quantities of other fish are brought in and usually thrown away, which could be utilized for fertilizer.

Keeping pace with the expansion of the sardine canning factories in California are the commercial reduction works which utilize the waste fish. At San Pedro there are several such reduction plants, with a combined capacity of about 1,200 tons of fish per day. In three months these reduction plants handled a total of 15,718,006 pounds of fish, ranging from sharks to sardines, but on some days the run of fish was so great that the plants could not handle them, and in a single day the health department required the dumping out to sea of 185 tons of sardines that could not be handled.

## The Romance of Invention—XVII

(*Continued from page 282*)

which another worked, or duplicate his own work with mathematical exactness.

The use of tungsten as the target or anode has greatly increased the capacity of the tube for both life and work, on account of its resistance to heat. Under the bombardment of electrons from the hot cathode the target gets greatly heated—indeed, it is perfectly possible to melt even a solid tungsten target if no artificial cooling is resorted to, because more than ninety-nine per cent of the energy input in an X-ray tube is changed in the target into heat. Dr. Coolidge has devised several different systems of cooling, using water, a radiator and a fan, a radiator which is air-cooled direct, and an oil-immersed tube which obtains better cooling as a by-product of its construction, the real reason for immersing the tube in oil being to eliminate the danger of electric shock to operator and patient.

Dr. Coolidge is constantly experimenting on X-ray tubes and accessories. One of the latest developments is the air-cooled, radiator-type tube. To understand the real importance of this improvement it is necessary to remember that while a solid tungsten target tube is capable of rectifying its own current, it does so only with such amounts of energy input as do not heat the target to a temperature approximating that of the cathode. When such a degree of heat is reached the target begins emitting electrons, and if the energy supplied is an alternating potential, an "inverse" current passes. This "inverse" cathode-ray stream hits the glass just behind the cathode, heats and usually cracks it, and of course ruins the tube. The trouble is cured, as far as danger is concerned, by having a cathode-focussing device of either tungsten or molybdenum, which is so designed as to intercept the "inverse" stream; but while efficient as a safety device this does not permit an increase in capacity of the tube. What is wanted is more power in one stream of X-rays, not two streams from two different points.

To increase the capacity of a self-rectifying tube it is necessary to take away heat, so that no "inverse" current shall be formed. Moreover, without some cooling system, the waits between operation for cooling of the heated target are long. With the fin-type radiator of copper connected to a copper anode-arm with a tungsten target (copper being a much better conductor of heat than tungsten) the tube can be used much longer than with the usual uncooled tungsten anode, without undue heating; and it cools with relative rapidity between uses, because of the good conduction and radiation of heat by the copper anode and fin radiator. Inasmuch as in the new tube, the greater part of the heat energy is radiated through the radiator and not through the glass, the glass tube may be much reduced in size (3¾ inches is now a standard).

Another contribution to the physician which has recently come from Schenectady is the portable X-ray outfit, which attaches to any lamp socket and may be carried in a physician's automobile. The advantages of carrying the apparatus to the patient rather than the patient to the apparatus are obvious. Indeed there are many cases where lives might be saved could X-ray pictures be made, which must be lost because of the impossibility of moving the patient. Time and expense are always to be saved by the use of a portable X-ray outfit, not to mention suffering, as in the case of broken bones, which should be photographed. This however entails difficulty and pain if the patient must be ambulanced to a hospital and back again.

The portable outfit includes a stand to hold the tube, a transformer and a control apparatus, which is so simple as to be fool-proof and which also makes automatic exposures possible. The tubes to be used with this outfit are of a new, small type made of very thick glass which is fifty-five per cent lead, giving the same protection to operator and patient as a one-sixteenth-inch sheet of pure lead. The X-rays can escape from the tube only through a small window of lime glass.

Dr. Coolidge's work must be considered in the light of the great resources supplied him by the electric company and the facilities and assistants provided. Dr. Coolidge desires that full credit be given the many assistants who have helped in the development of ductile tungsten, the hot cathode tube and the other improvements made in X-ray outfits. For instance, were it not for the Langmuir mercury-vapor vacuum-pump no such high vacuum as is now produced in X-ray tubes would be possible. Without the conveniences and the disregard of necessary expense for lengthy and tedious investigations, no such developments as have taken place in either the arts of making over the most refractory metal in existence into a tractable substance, or of producing X-ray tubes which are instruments of precision rather than hit-or-miss X-ray producers, would have occurred.

In the development of Roentgenology lie the greatest possibilities both for the cure of certain difficult ailments to which the human machine is subject and the diagnosis of others which, without some such investigatory methods, can be treated only by hope and guess work. It is well realized that the science is only in its infancy, and that, with increased penetration, that even approaches the most penetrating radiations of radium in character, much that is new is yet to be discovered and much that is helpful is to be developed. The man whose efforts have accomplished so much in this department of research is young, enthusiastic, vitally interested in his work, and with plans made ahead which already promise even more interesting developments and discoveries than those which he has already to his credit. He is to be congratulated upon having found a place in the organization for which he labors, but the general public is even more to be felicitated that the great research laboratory at Schenectady should have made its own so original and enthusiastic a scientist as the subject of this sketch.

Engineering

IN THIS ISSUE:

SOLVING THE LABOR PROBLEM
THE TOOLMAKER'S TOOLS

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

SUBMARINE S-5 SIGNALLING FOR HELP THROUGH HOLE CUT IN STERN—[See page 298]

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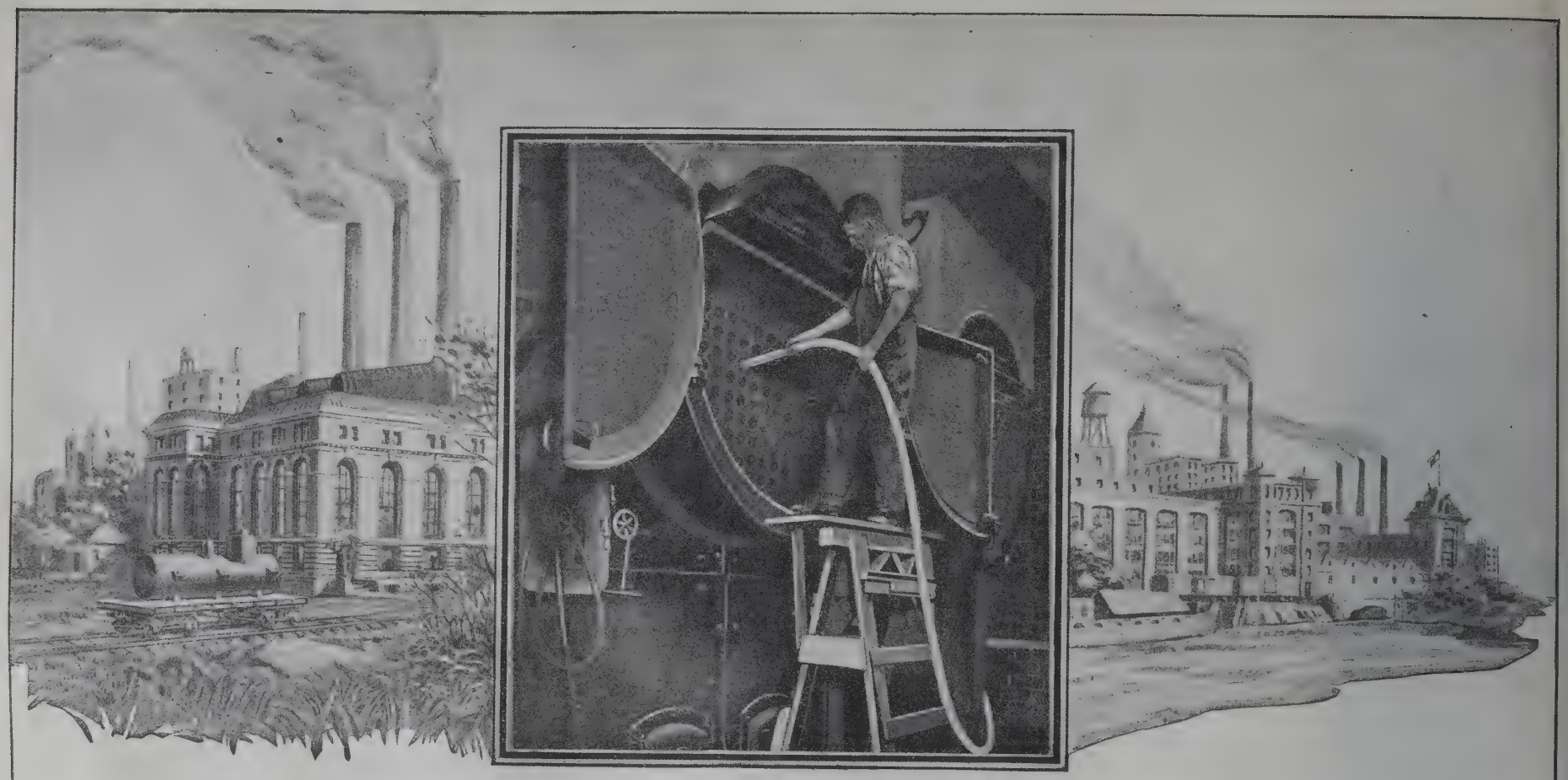

# Steam Hose Must be Reliable

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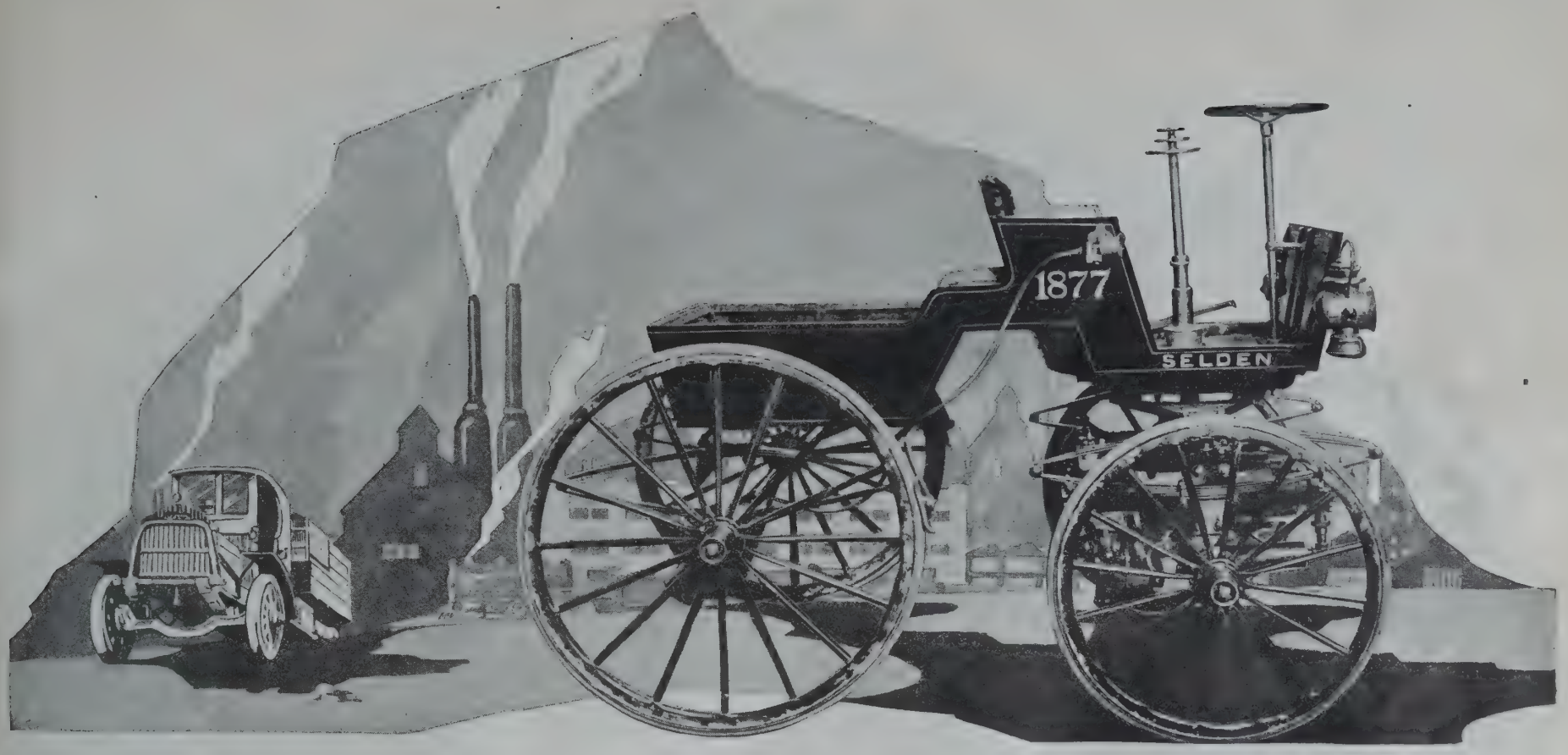


# The Beginning of the World's Second Largest Industry

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Selden Motor Trucks

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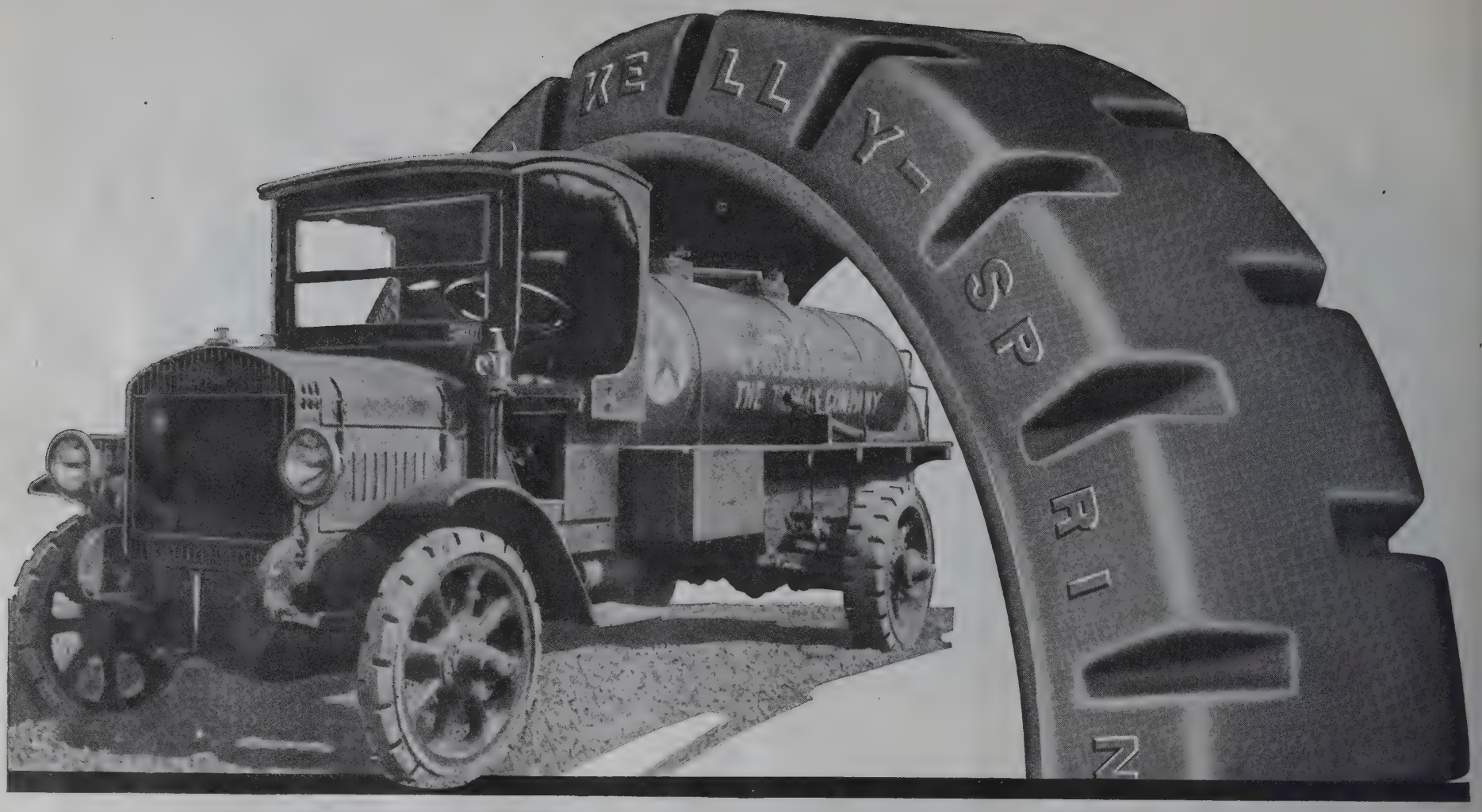


# Hard going doesn't stop these wonderful tires

"One thing we like about your Caterpillar tires," writes a big contractor, "is the traction our trucks are able to get with them. Only under the most exceptional conditions do we have to use chains. No matter how heavy the load, our trucks never have any difficulty in climbing out of excavations, and we find that Caterpillar equipment means a substantial saving in gasoline consumption."

The Caterpillar's amazing traction qualities seem to be the feature most frequently commented upon by truck owners; but it has two other equally important advantages.

It cushions the truck, and it gives double the average mileage of any other type of tire.

More resilient than a solid tire, more dependable than a big pneumatic, and giving greater mileage than either, it is not surprising that the Kelly Caterpillar has become almost exclusive equipment on some of the largest fleets of trucks in America.

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SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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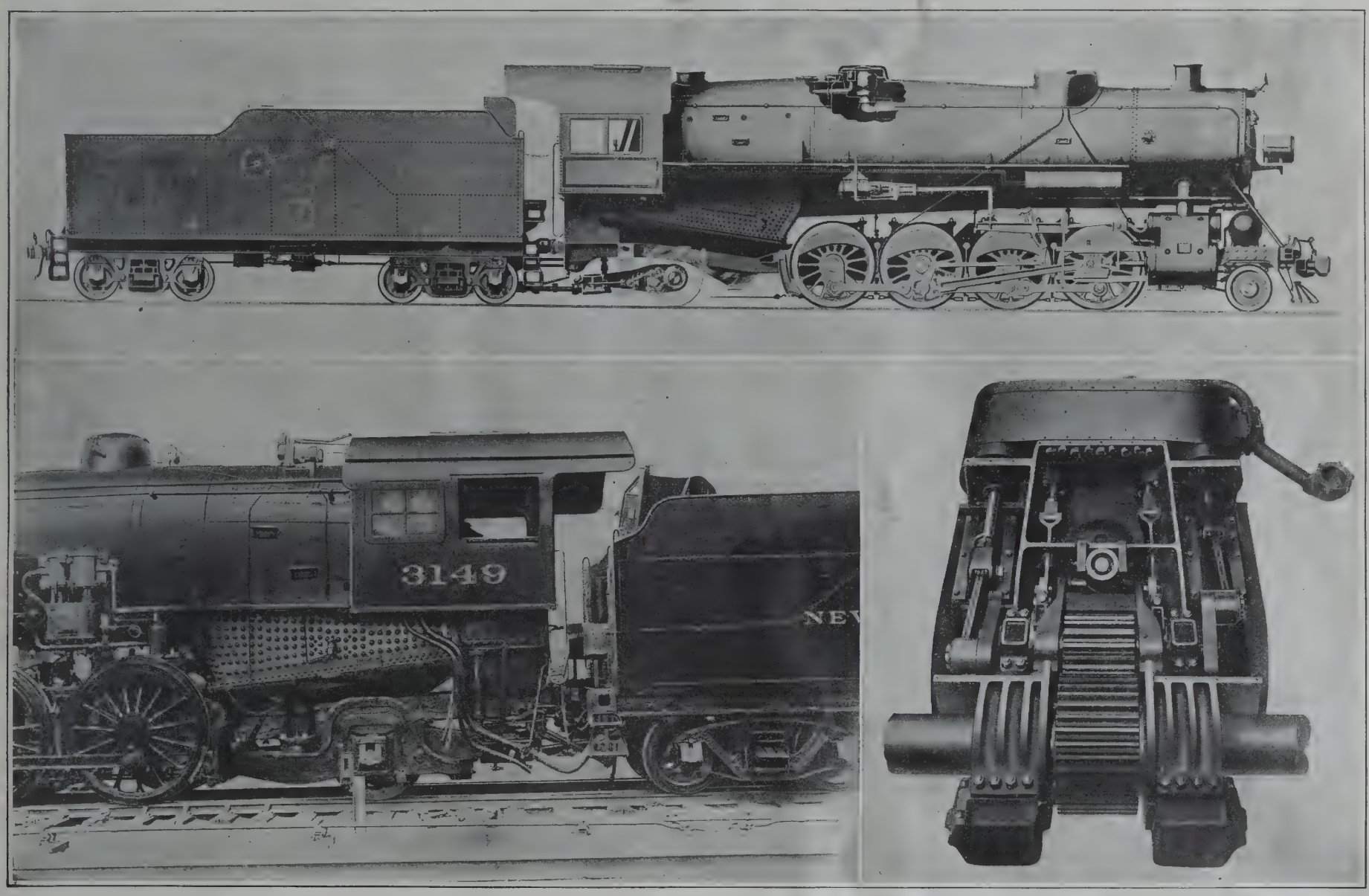


**Broken-away view of a locomotive fitted with the new booster, showing how this device is applied; a view of the rear end of a locomotive so equipped; and a view of the two-cylinder engine and gear drive comprising the booster**

## More Starting Power for the Steam Locomotive

THE locomotive booster is a power unit applied to the trailing wheels which, by utilizing their full traction, increases the drawbar pull by 25 to 40 per cent (depending upon the type of locomotive) at starting and getting up to road speed, and disengages automatically when the engineer hooks up the reverse lever. This device capitalizes idle weight and spare steam with negligible addition to the weight of the locomotive, and without increased demands on the engineman. Its control is semi-automatic, giving the engineman a maximum resource with a negligible minimum of attention to its operation.

Locomotives recently built employ weights bordering on the limit the track structure will bear. Yet their speed-pull curves nearly coincide with those of lighter engines of the same type. Greater starting and accelerating power is the principal advantage.

The locomotive booster, so it is claimed, gives an increase in starting and accelerating power equal to what 50,000 pounds additional locomotive weight would give. And the booster weighs only 3,500 pounds. So it may be said to avoid large investments for improved roadway and bigger locomotives.

This remarkable device has been hailed by many experts as the greatest advance in steam locomotive engineering in ten years. It reduces by one-half the time required to get trains to road speed. It is said to pay its own fixed and maintenance charges several times by avoiding slipping drivers and the consequent wear and tear on the main locomotive. When the train is up to road speed it has no more effect on the locomotive's operation than so much coal on the tender.

The booster consists of a simple two-cylinder steam engine, secured to and supported by a specially designed cast steel bed plate. This cast steel bed plate contains the axle bearings and supports all moving parts of the booster. Three-point support is provided, two bearings fitting on the trailing axle and a third, which is a ball joint, fitting on the back member of the trailing truck frame. This suspension gives sufficient flexibility to compensate for any torsional movement between trailing truck frame and axle, and in addition the ball joint is located near the center of gravity of the booster engine, thereby relieving the trailing axle of the weight and minimizing wear of the booster bearings.

The piston rod, connecting rod and crank-shaft follow general locomotive practice. The crank-shaft and driving piston are integral and are of heat-treated steel, liberally designed. Lubrication is taken care of by enclosing the entire engine and connections in an oil-tight steel case and using splash method. This automatically lubricates all bearings except the main bearings on the trailing axle, which are lubricated in the same manner as is employed for car journal boxes, *i. e.*, a waste-packed oil box.

The control valves are air-operated. Indeed, practically push-button control is provided. Nothing is left to judgment except the use of the device when needed. All the engineer has to do is to raise the latch on the reverse quadrant. Operating the locomotive in the usual way automatically operates the booster. It can only be brought into operation when the latch on the reverse lever quadrant is in operating position, when the main locomotive throttle is open,

(*Continued on page 312*)

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## An Announcement

IT is with great regret that we announce the necessity of increasing the subscription price of our publications—a necessity imposed upon us by abnormal conditions in the publishing business. At present prices and under present conditions our publications can be produced only at considerable loss. Our manufacturing costs, barring the single item of paper, have increased 200 per cent; the cost of paper has increased 300 per cent since the beginning of the war; postage under the zone legislation has increased 200 per cent. Like most other publishers, we have hesitated to take the drastic action necessary to meet these increases, until it had become entirely clear that it was a permanent rather than a temporary condition that faces us. Stabilization of business on a new basis has gone sufficiently far for us to be assured now that this higher level of costs will not be materially abated, at least for a long time. In company with conservative publishers everywhere, we therefore find it necessary now to readjust the selling price of our product to conform with the new conditions.

Beginning October 2nd, the price of the SCIENTIFIC AMERICAN will be advanced from five to six dollars, annual subscription; that of the SCIENTIFIC AMERICAN MONTHLY will be advanced from five to seven dollars, annual subscription.

In spite of the serious difficulties which have confronted the publisher during the past twelve months, the high standard of the SCIENTIFIC AMERICAN has been maintained, and the subscriber has been given the same excellent quality of reading matter that we have furnished in the past. The same will be true of the future; we shall continue to cover as we have always covered our field of applied mechanical science, invention and industry.

While it would be impossible to catalog all the features of the coming year, and wearisome even if it were possible, several outstanding high lights clamor for mention. A kind friend of the SCIENTIFIC AMERICAN has offered a prize of five thousand dollars for the best essay on the Einstein theories of relativity, and every thinking person will want to read the winning essay and its close competitors when these begin to appear in our columns. Earnest watchers of the stars follow our monthly astronomical article by Professor Russell with great interest. The tale of the successes which great inventors have attained through the establishment of commercial plants and the development of their inventions will continue in the series of articles "The Romance of Invention." The extraordinarily useful summaries in briefest possible form of the achievements of science and technology here, there and everywhere will continue to make the SCIENTIFIC AMERICAN of the greatest value to the busy man who must know what the world is doing. In the future as in the past the progress of aviation and the other new arts will be fully chronicled.

It is the purpose of the SCIENTIFIC AMERICAN, almost before all else, to publish up-to-date articles upon the latest inventions that are brought to public notice. These discussions are timely and full of interest. It is the policy of the editor, and has been so ever since the days of the notorious "Keeley Motor," to expose fictitious claims which are put forward from time to time in regard to some startling discovery of doubtful authenticity, an especially valuable activity when such claims seem to be developed for financial reasons. The paper is designed to keep the reader informed of the latest news of the day along its particular line, and anyone who is a constant reader of the SCIENTIFIC AMERICAN will find himself to be better informed by such reading, not alone with reference to his own particular line of work but as to what is going on in the scientific and industrial world at large.

## To Render Travel by Air Safe

TO those of us who wish to see the future of commercial aviation assured, it is extremely disconcerting to notice that the number of fatal accidents in aviation appears to be on the increase, and this increase, it should be remembered, is not by any means proportional to an increase in the number of machines and pilots; for the rate of increase of accidents is out of all proportion to the growth of flying as a sport and a commercial industry. The details of these ever-recurring accidents as given in the daily press show that far too many of them are due to exhibition flying, air "stunting" and the demands of the "movie" men and the daily press for sensational and novel pictures. Another contributory cause of disasters is the great scarcity of flying fields and proper landing places at a time when great efforts are being made to promote long-distance travel by air.

There can be no denying that the situation is such as calls loudly for government assistance and control. Any day of the year airplanes may be seen flying low over cities and villages, and it is only a month since a machine engaged in photography narrowly missed crashing among an assembled crowd of 10,000 people. There is a growing note of protest against these practices, and it is fully justified by the serious risks to which the public is daily being exposed. We have heard a good deal of talk during the past two or three years about the need for legislation and the formulation of strict laws governing the use of the air; but if any such rules, State or municipal, exist, they are honored more in the breach than in the observance.

The evil of all this lies in the effective way in which it tends to kill that public appreciation and confidence, which is absolutely necessary if commercial aviation is to make any headway in the United States. Unquestionably the perpetually recurring disasters of the past few months, a large proportion of which have happened to skilled pilots of long experience, is doing much to shake public confidence.

That we are not playing the part of alarmists or unduly exaggerating the increasing flying accidents is proved by the fact that in Europe they have found a means to make flying the safe and attractive form of travel which it is entitled to be. Testimony to the truth of this statement comes from that well-known and successful designer of airplanes, Edson F. Gallaudet, who with his associate, W. B. Lebherz, has just returned from a two months' tour of Europe, where they found that the aircraft industry is in the midst of extensive experimentation out of which it is expected there will be evolved new types of material and construction for long-distance aerial transport. In this important work, we are told, the manufacturers even in Germany are receiving the active support of their governments. This support in the case of England and France does not take the form of large appropriations, but consists of the passage and enforcement of laws regulating aerial traffic; licensing of pilots and inspection of aircraft; the prosecution of technical investigations into new metals and alloys which will increase the safety and enhance the durability of machines; and, finally, in the appropriation of small amounts for experimental development sufficient to enable the manufacturers to remain in business, thereby assuring the possession of construction facilities in case of future national need.

Mr. Gallaudet ascribes the present unsatisfactory condition of our airplane industry to the fact that we do not have the advantage of the national coöperation which is enjoyed abroad. He believes that this lack is reflected in America in the repeated number of fatal accidents following our disregard for the common rules of flying.

Thus, we are told that during the two months these gentlemen were in Europe, there was only one airplane accident in England and none in France or Germany of which they heard any mention or saw any record. The result of this immunity is that abroad there is a general confidence in the safety of air travel. They attribute the scarcity of accidents abroad to the existence of severe regulatory national laws and their strict enforcement by centralized aeronautical branches of the Government, which normally makes improbable the dangerous practices which are common in the United States. As an instance of this, they quote the fact that in England a flyer was fined $250 in police court for making several Immelman turns at a height of 500 to 600 feet from the ground. They were given an opportunity to study the actual results of the British national policy of regulating flying and encouraging its development by making it safe. They found that in the preceding twelve months within the British Isles alone, nearly 700,000 miles had been flown by airplanes of all types with only 24 accidents and 4 fatalities.

## Setting Our Industrial House in Order

THE conclusion of the war found the nations of Europe with empty storehouses and their stocks of a thousand necessary commodities, both raw and finished, depleted. Until such time as they could set their house in order, they turned to the United States as the only possible provider on the enormous scale demanded by their crying necessities, with the result that our export trade expanded by leaps and bounds to unbelievable figures. It was realized that the conditions were temporary, and the unfavorable rate of exchange, coupled with the unexpectedly rapid return of European industries to normal peace-time conditions, had the inevitable result of greatly reducing the volume of our export trade to Europe.

The slowing down of the foreign demand should have a most favorable effect on the solution of our own great problems of readjustment and reconstruction. Not alone during the war but also in the two years that have passed since the armistice, the industrial effort of the United States has been diverted from its own internal necessities. Our vast railroad system has been so greatly neglected that a conservative estimate by expert railroad officials has placed the total expenditures that must be made before the railroads have caught up with the enormously increased traffic demands, at the huge figure of five billion dollars. Recent favorable legislation and the belated increase in rates will render the railroads, it is hoped, so desirable an investment as to lead the public to invest on a sufficiently generous scale to provide the funds for reconstruction as they are needed.

Another equally urgent domestic problem, intimately bound up with the railroad problem, is that of housing. There can be no return to normal conditions until the present distressing shortage has been relieved. In no direction was our diversion of effort, both during the war and after, so grievously felt as in this matter of providing homes for the people to live in. That a man shall have a roof over his head is a demand only less insistent than that he shall have food in his mouth.

The capital and energies that have been spent so freely in supplying the needs of an impoverished world should now be concentrated very largely on the task of providing sufficient houses for the people to live in. In this matter we have not shown the enterprise with which some of the debt-burdened nations of Europe have taken hold of the problem. There has yet to be formulated a broad, well-thought-out plan; and it would be well if the leaders of both parties would substitute for the reprehensible politics of the day, to which the public shows a contemptuous indifference, a little real constructive legislation on a subject in which the whole country is vitally interested.

There is no doubt that agriculture has suffered greatly by the influx of workers from the country to the cities as the result of the abnormal industrial demands of the war and the post-war expansion of our export trade. Already the closing or slowing down of industrial plants is causing a reversal of the tide of labor. The flow is now from the cities to the country, and agriculture—basis of permanent prosperity—seems about to come, once more, into its own.

## Naval and Merchant Marine

**The New Navy Hangar.**—The new naval hangar at Lakehurst will accommodate two dirigibles, both more than twice as large as R-34. In fact, it will be larger than any hangar in existence. The length is nearly 1,000 feet, the width, 318 feet, and the height, 210 feet. The double doors are each 177 feet high and 136 feet wide.

**A Record Parachute Drop.**—The official record for a parachute drop has been accredited to Lieutenant John H. Wilson, U.S.A., of the 96th Aero Squadron, Kelly Field, Texas. There has been a question as to whether a parachute would open satisfactorily in rarefied atmosphere. The Lieutenant demonstrated that it would when he leaped from an army airplane at an altitude of 19,861 feet, and seventeen minutes later made a safe landing.

**The Question of Personnel in Our Navy.**—Representative Fred A. Britten, of the House Committee on Naval Affairs, is right when he says that we should now give our attention to the rounding out of the fleet, the development of the merchant marine and the securing of an adequate and well-trained personnel. The first step to be taken is to secure men for the new ships which are now under construction. The Navy should give equal if not greater attention to the question of personnel than to that of the completion of our new battleships and battle-cruisers.

**Panama Canal Traffic.**—Traffic through the Panama Canal for the year ending June 30, 1920, exceed that of any previous year. A total of 2,478 merchant ships passed through the Canal with an aggregate net tonnage of 8,545,653 tons. In the fiscal year 1918-19, 2,025 ships pased through the Canal, and their aggregate was 6,131,575 net tons. The aggregate revenues approximated $8,800,000, and the expenses of operation and maintenance were about $6,650,000. This, however, takes no note of the interest charges on the cost of the Canal or of the depreciation of the plant.

**Our Latest Battleships and Battle Cruisers.**—Our latest battleships of the "Indiana" class, of 43,200 tons displacement and 23 knots speed, carrying twelve 16-inch guns, will be electrically driven. The turbines of 60,000 combined horse-power will develop their full rated load at 265 pounds pressure, 50 degrees superheat, and 28½ inches vacuum. The six new battle-cruisers of 43,500 horse-power and 35 knots speed, carrying eight 16-inch guns, will also be driven electrically. Two of them, the "Ranger" and the "Constellation" will carry four Westinghouse turbines of 49,750 brake horse-power, the current from which will be developed on eight Westinghouse motors, each of 22,500 horse-power.

**Franklin Medal to Sir Charles Parsons.**—The Franklin medal has been awarded to Sir Charles Parsons "in recognition of his epoch-making success in the development and the construction of the steam turbine which has revolutionized the art of steam engineering, particularly in regard to the propulsion of mercantile and naval vessels, and the driving of electrical generators." Not many people know of the courageous struggle of Sir Charles in the early days of his invention, and that he separated from his original partners owing to their becoming too discouraged to "carry on." *Engineering*, in speaking of the ward, says: "The work of Sir Charles Parsons has halved the cost of producing electric power and reduced in still greater proportion the capital cost of engineering machinery."

**The World's Merchant Shipping.**—It is estimated by Lloyd's that as a result of the action of enemy submarines and the diversion of resources normally employed in replacing losses and constructing new tonnage, the net reduction in the merchant shipping of the world during the last six years amounted to 3,516,000 tons, this figure being based on the assumption that the ratio of increase during the last six years would have been four-fifths of the average rate of increase during the previous six years. The United Kingdom leads with 18,111,000 tons, and the tonnage for the whole empire, including the British Dominions, is 20,143,000 tons. The United States comes next with 12,406,000 tons, the total for this country having thus grown since 1914 when it was 2,027,000 tons.

## Astronomy

**The Total Number of Minor Planets.**—M. Paul Stroobant, director of the Royal Observatory of Belgium, has made an estimate, by two different methods, of the total number of asteroids, or minor planets, brighter than the 20th magnitude. The result, according to one method, is 57,000, and, according to the other, 100,000. M. Stroobant believes that very few of these bodies brighter than the 12th magnitude remain undiscovered.

**A Minor Planet Mistaken for a Comet.**—According to *Astronomische Nachrichten*, it has been discovered by F. K. Zweck that the object heretofore known as Comet 1908 *a* (or, in some catalogs, Comet 1907 VI) is identical with the minor planet 516 Amherstia. This body was at first taken for Encke's comet, and afterward for a new comet with a large perihelion distance. The orbits of Encke's comet and Amherstia approach each other within 2,000,000 miles in about longitude 310 deg. and within 5,000,000 in about long. 358.

**Unexplained Irregularities in Lunar Motion.**—In a recent address before the Astronomical Society of the Pacific on "The Problem of the Moon's Motion," Prof. E. W. Brown discussed, *inter alia*, the curious semi-regular fluctuations of the moon from its theoretical position first discovered by Newcomb. The earth, Mercury and Venus have been found to exhibit deviations of a similar character, though smaller in amount. The irregular character and comparatively great magnitude of these fluctuations, says Prof. Brown, suggest that there is some set of forces acting on the bodies of the solar system related to the known irregular changes in the condition of the sun. The period of rotation of the sun's magnetic axis found at Mount Wilson is sufficiently close to that of one of the principal lunar periodic terms known as the evection to suggest a long-period change by the phenomenon known as resonance. Long continued observation will, however, be necessary to enable us to ascertain the merit of this suggestion.

**A Century of the Royal Astronomical Society.**—The annual general meeting of the Royal Astronomical Society held last February marked the hundredth anniversary of the foundation of the society, the early history of which was set forth in Prof. Fowler's presidential address. The organization was launched at a meeting held at the Freemasons' Tavern, in London, Jan. 12, 1820, and the prime mover in the undertaking appears to have been the Rev. W. Pearson. The first general meeting of the newly constituted society was held at the rooms of the Geological Society Feb. 8, 1920, thus establishing the custom still maintained of holding the annual meetings in February. The Duke of Somerset was elected president but declined to serve, and the first actual holder of the office was Sir William Herschel. The *Monthly Notices* of the Society, now an indispensable part of the reading of astronomers throughout the world, date from 1827. In 1830 King William IV became patron of the organization and its name was changed from the Astronomical Society of London to the Royal Astronomical Society.

**To Determine Australian Longitudes by Radio.**—In marking out the boundary between South and West Australia, defined by imperial act as the 129th degree of longitude east of Greenwich, it is proposed to determine an initial point on the line by utilizing longitude signals from a high-power radio station located at some point between Greenwich Observatory, in England, and Sydney Observatory, in Australia, the signals to be received simultaneously at these two points. This undertaking will be the first step in a comprehensive scheme involving the redetermination of the whole longitude system of Australia. A committee has been appointed to carry out the work in Australia, comprising the government astronomers of New South Wales, Victoria, West Australia, and South Australia, the commonwealth surveyor-general, and the director of the Royal Australian Navy Radio Service. It has been ascertained that, under favorable conditions, signals from Lyons can be successfully received in Australia as well as at Greenwich, and signals from other stations more symmetrically situated are also being tested. The coöperation of the United States, as well as the British Government, has been invited.

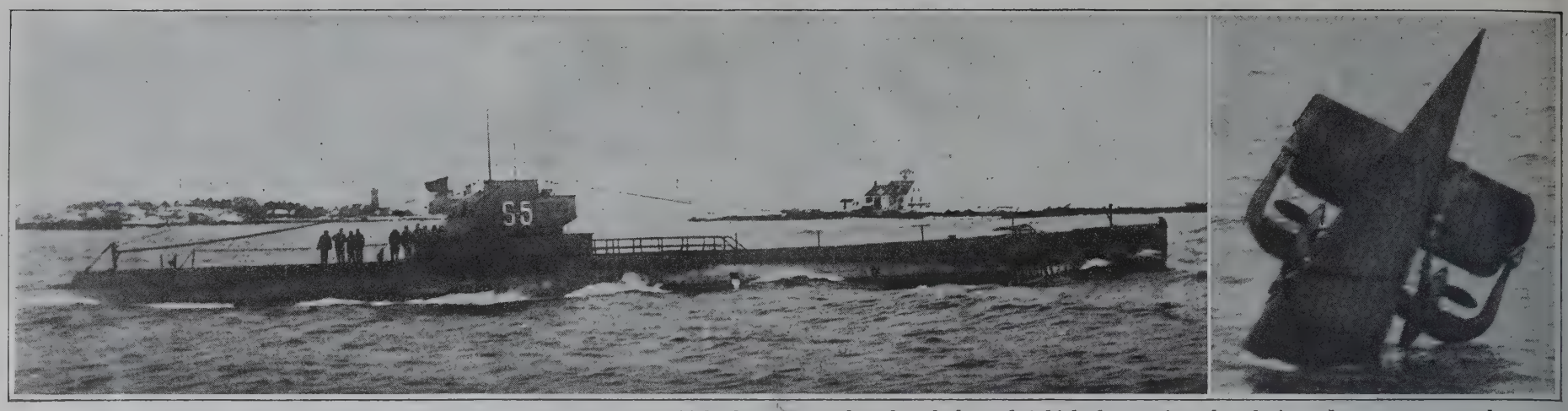
## Automobiles

**Material Market Limits Car Production.**—One of our mechanical contemporaries, *Machinery*, states that the automobile industries appear to be fairly well supplied with machine tools for present requirements, though some of the larger companies are still buying. Gear manufacturers are exceedingly active, and a large percentage—in some cases from 75 to 80 per cent—of their product goes to the automobile and truck industries. It is estimated that the output of the automobile and truck builders for this year will amount to 2,250,000 cars. It may not be possible for all the automobile builders to complete as many cars as planned on account of the decided shortage of certain classes of material. Sheet steel is scarce, and cold-rolled stock of some sizes can be had only in small quantities. This is a serious drawback in the metal-working industries.

**Belgian Auto Industry.**—Before the war there were twelve automobile factories in Belgium, located in the neighborhood of Liege, Charleroi, Brussels and Antwerp, employing 4,000 to 5,000 men. The annual production, chiefly private cars and motorcycles approximated 4,500 to 5,000 automobiles and chassis and 7,000 to 8,000 motorcycles, with a total value of some $11,000,000. Mass production in series of standard types of automobile is not characteristic of the Belgian plants, but special attention is given to the construction of engines and in satisfying the foreign market, especially South America, as to form and decoration. There is a market in Belgium at the present time for American automobiles. The machines desired are those of a moderate price. It is necessary that they be strongly built as many Belgian roads are of cobblestone construction.

**Inspect Ignition System.**—The ignition system of an automobile should be inspected carefully to learn if all wires are intact, that the terminals are bright and clean, and the insulation is not saturated with oil or grease. The terminals should all be soldered and the wiring should be taped wherever it may chafe. The spark plugs should be taken out, disassembled and cleaned with gasoline. If the porcelains are heavily coated with carbon they can be soaked in kerosene until it softens, when it can be wiped off. Don't scrape the porcelain, as this may remove the glaze. The shells should be cleaned by scraping. When assembling, care should be taken not to seat the insulators too tightly upon the gaskets, but the plugs should endure a pressure of 250 to 300 pounds without leakage at the gaskets. The spark plug points should be scraped or polished bright and set 1/64 inch apart if magneto-ignition and the thickness of a dime worn smooth if battery ignition. The breaker box and distributor of the magneto can be cleaned by blowing out the dust with an automobile tire pump and by wiping with a cloth dampened with gasoline. The distributer or timer should be similarly cleansed.

**Why Clutch Acts Harshly.**—A grabbing action of the cone clutch is occasioned either by the leather facing becoming very dry through use or by wear, causing the rivet heads to protrude above the leather face and come in contact with the metal of the flywheel. A dry clutch can be restored by sponging off the face of the leather with kerosene and applying a dressing of either neats-foot oil or castor oil till the leather again becomes soft and pliable. If the leather facing is worn down to such a point that the heads of the rivets come in contact with the metal cone of the flywheel, the clutch will stick, and to restore the clutch it will be necessary to drive down the rivet heads into the leather so as to clear the cone. Leather facing that has become rough or uneven through wear can be restored by rubbing off the high spots with emery cloth, broken glass, a coarse file, or sand paper, making the surface smooth. A new leather should not be refitted unless you are absolutely certain that the old leather cannot be reclaimed. When new leather is refitted, it is best to take the car to some good repairer and have him purchase a facing from the factory and fit it correctly. After the new leather has been fitted it will take some time for it to fit itself to the cone of the flywheel and in the meantime it will require frequent dressings with either neats-foot or castor oil.




*Left:* S-5 running at the surface. *Right:* Stern of S-5 within which the crew gathered and through which, by cutting the plating, they were rescued

# The Disaster to One of Our Latest Submarines

## How an Air Valve, Inadvertently Left Open, Caused S-5 to Plunge to the Bottom

THE story of the sinking of S-5, one of our latest submarines and of the fight for life, lasting for thirty-seven hours, of the officers and crew, forms one of the most dramatic among the many weird experiences which have befallen various submarines during the past twenty-five years. It is not our purpose here to tell in detail the story of the desperate struggle of the entombed crew to escape. That has been done in very full detail in the daily press by the commanding officer of the vessel, Lieutenant Commander Charles N. Cooke.

The S-5 left Boston on a Monday on a 72-hour endurance run to Baltimore, during which everything functioned satisfactorily. On the following Wednesday she made a "crash dive" at a point 55 miles southeast of the Delaware Capes. The vessel responded to the diving rudders, but failed to straighten out after submergence and dived down until her bow was embedded in the sea bottom. Ultimately by blowing out the main and after tanks, the stern was lifted until the vessel stood in the position shown on the cover of this issue. The crew cut out a small hole through the projecting stern and by means of a brass rod with a sailor's undershirt tied to it, managed to attract attention. Finally, after thirty-seven hours of peril, a hole was cut by the rescuing ships through the hull of the submarine of sufficient size for the rescue of the crew.

It is gratifying to read the following statement in the story of the disaster as given by the Commander: "Next to my inexpressible admiration and praise for every officer and man in my crew and my pride in their courage and fortitude, my deepest feelings are those of gratitude to the officers and crews of the "Alanthus" and the "General Goethals" who so heroically and tirelessly labored to effect our rescue."

With a view to explaining what happened to S-5, we publish an approximate longitudinal section of the vessel, showing in a general way the various compartments and the ballast and trimming tanks, together with the position of the air valves and piping through which the water which sank the vessel found entrance. Successively, the various bulkheads divide the submarine into a forward trimming tank, a torpedo room, crews quarters, central control compartment, engine room, motor room, and after trimming tank. In the lower part of these compartments there are also the forward and after ballast tanks, the main ballast tanks and the fuel tanks, together with the accumulator batteries.

Contrary to popular conception, a submarine spends ninety to ninety-five per cent of its time upon the surface, and navigation, even in war time, takes place on the surface except when enemy ships are in sight or an attack is to be made. When the vessel is submerged, all bulkheads, manholes, et cetera, are tightly closed; but when running on the surface the bulkheads are open throughout the vessel and ventilation is secured by means of a system of air pipes connected with the outside atmosphere and provided with valves where the pipe enters the various compartments. In our sketch, this pipe is shown by a heavy black line. The intake is by means of a vertical pipe terminating outside the hull, in rear of the conning tower, and provided there with a valve, which is operated by means of a hand-wheel and vertical rod from the central control compartment within the hull. The vertical pipe connects with a horizontal air pipe, which is laid along the outside of the hull proper of the submarine and has connections with the torpedo room, the central control compartment, the engine room and the motor room. The passage of the air into the various rooms is controlled by overhead hand-operated valves as shown in the drawing.

When the submarine is running at the surface, these ventilating pipes with their valves are all open and the bulkhead doors connecting the various compartments are also open. Fresh air is drawn into the submarine, passes through its whole length and is ultimately drawn into the engine and discharged through the engine exhaust.

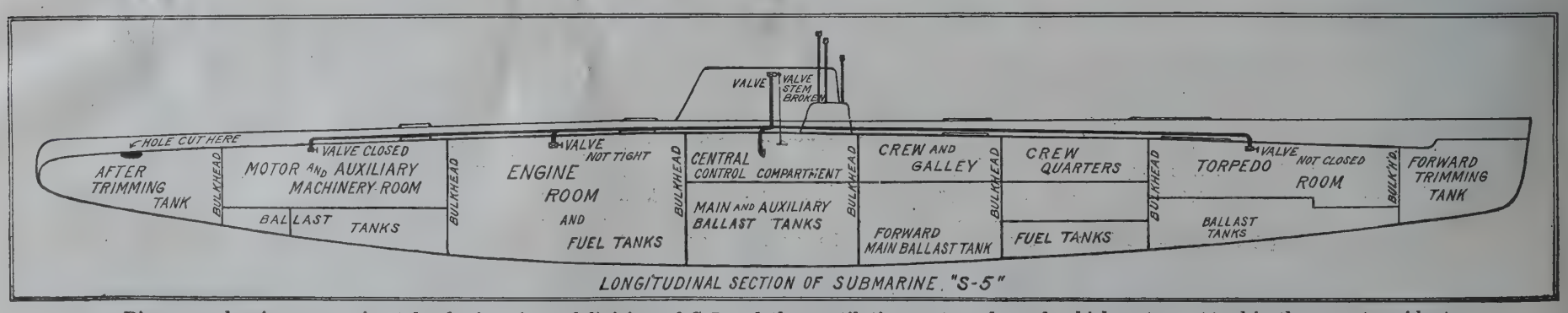
At the time the accident happened, the S-5 was making what is known as a "crash dive." To make this dive the vessel is first brought awash with her ballast tanks filled and with some fifty to one hundred pounds of positive buoyancy. When the order to dive is given a klaxon horn sounds in the various compartments and all doors are closed and all ventilating valves shut down, including the one abaft the conning tower. The oil engine is disconnected and the motors are connected up and started. The diving rudders are then depressed sufficiently to cause the submarine to descend at an angle of about eleven or twelve degrees with the surface. In a crash dive a well-balanced submarine with an expert crew can pass out of sight in from 48 to 52 seconds.

In making the dive off the Delaware Capes everything went according to schedule until Commander Cooke elevated his diving rudders to bring the S-5 to a level keel. Instead of responding, she kept on going, and finally drove her nose into the mud with a jar which was felt throughout the vessel. Immediately a man from the torpedo room ran into the central control compartment and reported that the torpedo compartment was flooding through the air valve. Water also began to come into the engine room, and it was at once evident to Commander Cooke that the ventilating system was more or less open to the sea and that the valve at the top of the conning tower was open. Efforts were made to close the valve in the torpedo room, but without avail. Subsequently, and with much difficulty because of the steep inclination of the vessel, the various bulkheads were closed and the men drawn aft until the whole of the crew were in the three after compartments, the aftermost air valve in the motor room being tightly closed and the room free from water.

The S-5 had gone down in about 155 feet of water, and although her inclination was about sixty degrees, her great length of 231 feet sufficed to bring some

*(Continued on page 312)*

*THE outstanding lessons of the sinking of S-5 are first the imperative need for making up the complement of a submarine crew from the older enlisted men and, secondly, the insistent demand in the submarine service for that eternal vigilance which in this mechanical age is more than ever the price of safety. Before the war, submarine crews were selected from men in their second and third year of enlistment, and it was common to find a crew made up entirely of petty officers. The majority of these experienced men left the Navy for shore jobs that would enable them to live. The younger men of recent enlistment have not yet attained that automatic impulse to do the right thing in an emergency, which comes with lengthy service.*—THE EDITOR.




**Diagram, showing approximately the interior subdivision of S-5 and the ventilation system through which water entered in the recent accident**

## Timing the Hundred-Mile-Per-Hour Racer

By Ralph Howard

TIMING meteors or mammoth steel projectiles hurtled through space from America's biggest naval guns should be a task almost as easy as the accurate timing of automobiles speeding around oval race courses or on straightaway speed stretches, especially when Tommy Milton, the newest speed ace, cuts loose in his sixteen-cylinder Duesenberg racer at the rate of 156.047 miles per hour.

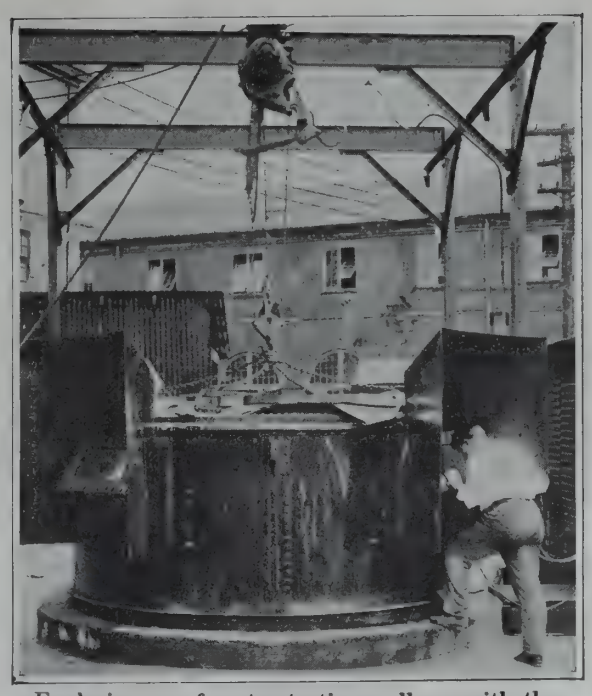
The human eye cannot discern a steel projectile in flight, so rapidly does it travel. And it is almost all the human eye can do to discern distinctly the speeding Milton when he steps on the gas pedals. He usually is just a blur. Experimental time computation tests conducted on a naval coast gun, have shown its 380-pound projectiles to have traveled 17,881 yards in 50.53 seconds. Actual time records show Milton to have traveled a mile in 23.7 seconds or 3752.32 yards in 50.53 seconds, while the projectile was going 17,881 yards. Therefore the steel missile, traveling at the speed of a mile and a fraction under five seconds, went only 4.76 times faster than Milton.

The projectile's speed was computed by measuring the time required for it to pass over a given space. But the time of Tommy Milton's record-breaking speed dash was accurately caught to the hundredth part of a second, the same as the time of every one of the twenty-three racers speeding around the Indianapolis oval recently, was caught on every lap to the hundredth part of a second by means of one of the most remarkable and most sensitively tuned instruments ever conceived in the brain of man.

Catching the time of twenty-three cars, all going at a speed varying from 88 to 93 miles an hour, on every one of 200 laps for each car—a total of 4,600 separate operations for the timing instrument—is not an easy task. It is a particularly difficult task when half a dozen snorting, lurching racing machines sweep past the timing stand in a bunch, for the separate time of every car must be caught accurately, even when there is only five-hundredths of a second's difference in time between the cars.

Otis A. Porter is the man who handles the timing of the Indianapolis speedway races. The timing instrument he uses is an assemblage of delicately tuned electrically corelated mechanical devices, and is so extremely sensitive that it registers in fractions of seconds up to even one two-hundredth part. Upon the precision and accuracy of this intricate machine naturally depends very largely the success and outcome of the race. One second's laying down on the job, one tiny slip-up, and some driver may be robbed of a well-earned victory. One hesitation in the operation of the instrument and the time of a dozen cars thundering down the speedway stretch may be lost, causing subsequent confusion and creating almost a hopeless muddle.

The important mechanism consists of a series of disks, four in number, with raised numerals, each disk graduated. The first disk, registering in hours, is connected with a second disk graduated in sixtieth parts and registering minutes. The third disk, similarly graduated, register seconds, and is connected with a fourth disk graduated in hundredths. The latter is connected electrically with the second hand of a ship chronometer. Every tick of the second hand



**Explosion-proof motor-testing gallery, with the chamber closed and the operator in position for observing results of tests**

sends the wheel around in one complete revolution, and every revolution of the hundredths disk "kicks over" the disk registering seconds. In turn every revolution of the second disk "kicks over" the minute disk one notch. A small steel wire stretched across the speedway course connects with the timing instrument. Whenever a car passes over the wire, the contact through electrical stimulus causes the timing device to record the time. A striking arm above the four disks strikes on a strip of paper, registering the imprint of the numerals on the four disks. The machine recovers from each operation quickly enough to permit another registration with less than five hundredths of a second elapsing. On a machine running 60 miles an hour, it is thus possible to catch the time of both the front and rear wheels as they pass over the wire, the two registrations showing four hundredths of a second difference. But when a car is exceeding 60 miles an hour the rear wheels do not register, the front wheels depressing the wire and the rear wheels whizzing over before the wire can rebound from the first impression.

As each car passes over the wire, an assistant calls out its number, the timer marking this number opposite the time recorded on the paper tape which is shifted forward with each registration. Scorers tabulate the laps made by each car, while the timer's assistants, by subtracting the time of the preceding lap from the last registration made, obtains the lap time and from it tabulates each car's complete lap performance and total time.

When Ralph DePalma qualified for the Speedway races on May 26 he made a new track record, ripping off four laps or ten miles in the total time of six

(*Continued on page 312*)

## Bomb-proof Coal Mining

By S. R. Winters

THE use of electricity in cutting coal is a desirable feature because it is easily adaptable to varying forms of service. However, apparatus heretofore used in fire-damp atmospheres—an explosive mixture of natural gas and air—was of such a character as to render extremely dangerous the use of electricity in mining coal. The recently approved explosion-proof coal-cutting equipment overcomes this major objection, according to claims. The testing outfit was coöperatively designed by the Bureau of Mines and a manufacturer of Columbus, Ohio, the latter constructing and installing the equipment as a gift to the Government.

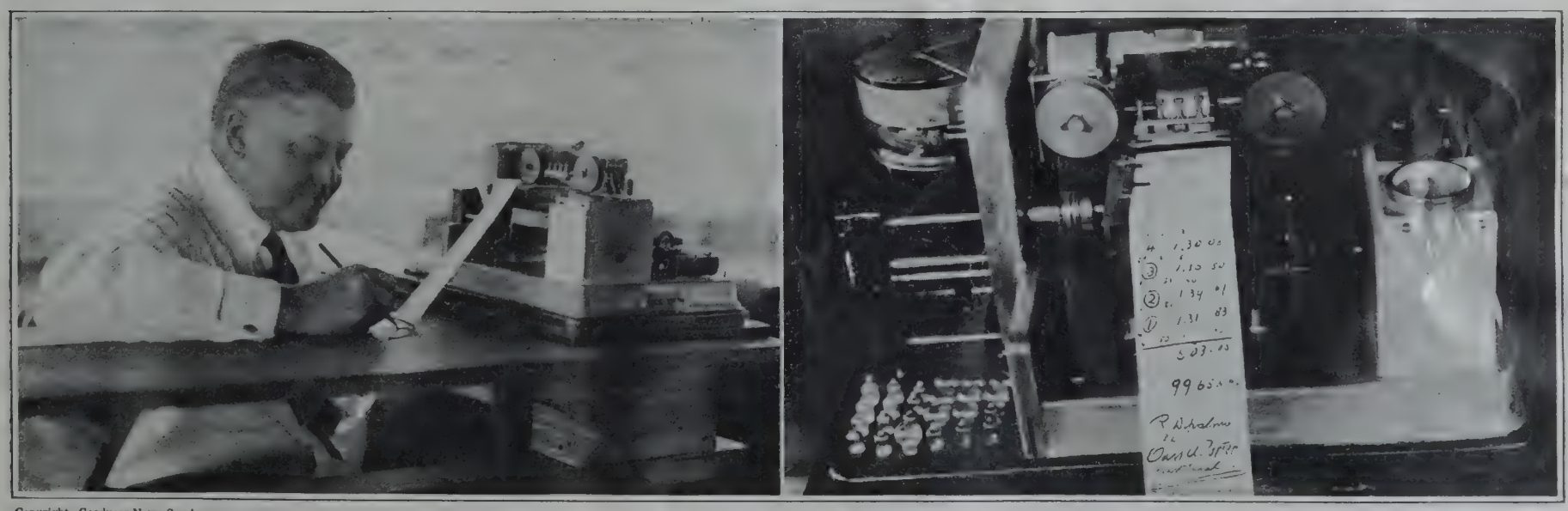
The explosion chamber of the Bureau's testing outfit is composed of a cylindrical steel tank, the internal diameter being 10 feet and the height 4½ feet. The cylinder is located in an iron channel-ring which is imbedded in a concrete base; the joint between the cylinder and the channel-iron is gas-tight through the agency of a water seal. There are four observation windows, the operator being protected from flames emitting from the top of the chamber by hoods. Canvas curtains are available for darkening the interior, thus facilitating a keener view of the results of the explosion. When the gas has been exploded the pressure is released by oiled-paper heads, which are held in position by iron rings. The bomb-proof gallery when not in use is preserved from the weathering elements by sheet-iron covers.

A fan and circulating system make possible the maintenance of uniform mixture of gas and air in the chamber as well as in the motor and other apparatus under test. The explosive mixture is discharged into the bottom of the chamber at two opposite points, the outlets being six inches from the cylindrical wall and so constituted as to give the gas and air a rotary motion. The gallery atmosphere and the entering gas are mixed in desirable proportions. The main suction line from the fan enters the chamber floor near its center.

Mounted on the switchboard are the controller for operating the crane-hoist motor, the switch mechanism which times the ignition with the release of the indicator drum, and the switch for operating the circulating fan and other circuits connected with the testing gallery. Below the switchboard are chains for opening and closing the valves in the piping connections of the equipment subjected to test. The operator is thus given the opportunity of filling one or more compartments with the gaseous mixture. A 3-ton electric hoist raises and lowers the cover or shifts the equipment in or out of the chamber, and is even capable of lifting the cylinder from the concrete base. Following each test the cover of the testing gallery is elevated to air out the chamber and permit of the entrance of the operator.

## Conservation in De-gumming Silk

IT is claimed that by a recent process raw silk may be de-gummed without the use of soap. It is proposed to treat the silk under pressure with water containing a small quantity of ammonia, borax, caustic soda, soda ash, or other alkali of similar character, for one-half hour. Distilled water is used as the solvent and the pressure employed is seven pounds.



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*Left:* Otis A. Porter, official A. A. A. timer, in the act of timing cars during the Indianapolis 500-mile race held on May 31st last. *Right:* General view of the electric timing device which times automobile racing cars to the hundredth part of a second, registering each car's time on the tape shown, by means of an electrical contact and the co-operation of a ship's chronometer. The tape shown here carries the actual record of DePalma's record-breaking four-lap dash of 10 miles at a speed of 99.65 miles per hour

**An official timer of automobile races and the electric device that records the speed of each car**

# The Oil-Field Geologist

## How Science Has Made Gambling on Petroleum Prospects a Thing of the Past

By O. R. Geyer

THERE is no more entertaining romance of the oil fields today than that of the oil field scientist, or geologist, whose discoveries have revolutionized the oil industry of the world and who, in the immediate future, will lead the desperate battle to bolster up the production of oil until it can more closely keep pace with the tremendous demand for crude and refined oil products.

Fewer than a dozen years ago the man who professed to be able to discover the location of Nature's secret oil pools without first running the hazardous risk of sinking test wells was about as popular in the oil fields as the fool who plays with matches in the vicinity of a newly tapped gas pocket. Hardened gamblers who had won and lost fortunes by "wildcatting" for oil pools looked upon the geologist with contempt and scorn. This was especially true in the oil fields of the West and Southwest, where the work of geologists in the Appalachian fields was not regarded as a serious contribution to the work of unlocking the vast storehouses of oil so craftily hidden by Dame Nature.

Conditions have changed vastly since those days in which the Mid-Continent field of Kansas and Oklahoma first smashed all records for production. Today the oil field geologist is a highly respected expert, and so great is the demand for his services that there is not enough of him to go around. Schools and colleges which specialize in turning out full-fledged geologists able to cope with the oil game cannot graduate them fast enough these days, and it will be many years before this type of expert becomes a drug upon the market. In fact, the demand for his services will increase in the same ratio as the consumption of oil increases over production.

The conservatism and efficiency of science have long since replaced the methods of the old-time "wildcatter." The oil barons are no longer content with "hit and miss" methods and are paying exceedingly well for the services of men who can reduce to a minimum the dry holes which plague the most resourceful leaders of the industry. The commissions earned by the geologists who have been successful in discovering new oil fields mount into fabulous sums. Many of these experts have long since become millionaires, fees of $500,000 or more belonging to the common, or garden, variety.

*HOW many of those discriminating investors who try to separate the sheep from the goats when they turn to oil stocks for investment realize that they are here backing science to unlock the secrets of Nature's storehouse of liquid gold? How many of them understand the revolution in methods which has come over the oil fields in the past ten years? No longer does the "wild-catter" flourish, the man who drilled for oil because he had a lucky "hunch," or because he thought maybe oil was there. Today the geologist precedes the driller, and while he cannot show a clean score of successful predictions, he has vastly reduced the hazard of unprofitable boring. How he has achieved this and what his success means to the industry are the theme of the present story.*—THE EDITOR.

The discovery of the Ranger, Burkburnett and Homer pools in the Southwest can be attributed in no small measure to the work of some of the best known oil geologists in the country. The Ranger and Burkburnett fields had scarcely been converted into "proven" territory before these experts were dashing out to all corners of the world in their frantic search for new oil pools. Today there is scarcely a nation in the world which cannot boast of the presence of one or more of these experts engaged in mapping out likely fields for the work of the prospector. Because of the ever-increasing inroads being made upon the reserve supply of oil, this search is approaching the stage of desperation. Even now experts are hinting broadly that the undeveloped oil fields can scarcely supply the world's needs for more than another quarter of a century.

Fuel oil has been substituted for coal as the motive power for hundreds of steamships, and this, too, has contributed to the enormous drain being made upon the country's reserve supplies of crude oil. A year ago it was estimated that the country's oil fields would have to increase their production by 50,000,000 barrels a year to prevent further inroads into the reserve supply. The demand for crude oil and its products has increased enormously since then, making it necessary for an even greater increase in production in case supply and demand are to be kept on even terms.

Hence the importance of the geologist. Thousands of these experts are combing the world today for possible oil "structures." Alaska, Canada, Mexico, Colombia, Venezuela, Brazil, Trinidad, Cuba, Russia, Rumania, Alsace-Lorraine, Germany, Great Britain, France, and various parts of Asia and Africa today are under the watchful eyes of oil geologists. Hundreds of millions of dollars must be expended in this work of prospecting and sinking test wells in all corners of the world, and there are billions awaiting those who are successful in the prosecution of this world-wide game of hide-and-seek with Dame Nature.

There is scarcely a paying field in Oklahoma or the Southwest whose location was not known definitely to geologists long before the drill began pounding its way into the bosom of the earth. Notwithstanding the excellent record established by science in locating oil pools, it is by no means perfect as yet. In proven territory it comes very close to a 100 per cent score, because in such cases the problem is not to locate new pools but to find the most advantageous point for the sinking of new wells.

Many of the larger and more conservative companies have drilling records of from 75 to 90 per cent in the way of successful producers, although many of these wells have been sunk in more or less unproven territory. Geology has done this, of course, and as experience multiplies there is no reason why this record should not be improved. The importance of advance knowledge of the location of oil pools will readily be understood when one appreciates the high cost of drilling these days. In Texas, where the oil sands are located from 2,000 to 4,000 feet beneath the earth's surface, an ordinary well costs from $25,000 to $50,000, and failures are exceedingly trying upon the pocketbook, especially in the case of the shoestring operator.

The remarkable results obtained by some of the best known geologists in picking out likely locations for wells and in casting out the bad spots would fill a book. The success enjoyed by one Sullivan, the geologist who mapped out the immensely prolific Burkburnett pool, is only one of the striking examples of the proper procedure in the exploitation of new oil fields.

Two years ago, when the rumbles of the approaching oil discoveries that were to startle all the world were heard in Texas, Sullivan was sent into what is now known as the Burkburnett district to prospect for likely oil pools. He studied this field exhaustively for miles in all directions, and mapped out what appeared to him every spot that could be drilled successfully as well as probable duster territory. Since that time hundreds of wells have been drilled in this territory, and so carefully did Sullivan select the sheep from the goats that oil men generally have scored him as a 100 per cent geologist.

The work of the geologist is based upon the anticline theory perfected in recent years. An anticline, one finds on consulting Webster, is "a fold or arch of rock strata dipping in opposite directions from an axis." Oil wells are drilled on these anticlines, commonly called drilling on "dome" or "structure." Geologists have found that the rock and sand strata in anticlines formed by the earth's convulsions are more productive of oil and gas than any other earth formation, and this has made the work of the prospector much easier than in the days of "wildcatting."

In beginning his work the geologist first seeks to find an unbroken fold or anticline of rock. He knows that in the pocket thus formed by nature he may find a pool of oil. This is by no means certain, however, for any number of things may have contributed to the lack of oil. The first and most probable is that a concealed break, hundreds of feet below the surface, may have allowed the gas and oil stored there to escape hundreds or thousands of years ago. The pool might have been formed as the result of one upheaval of rock, only to be drained by a second shock coming centuries later. Earthquakes, for instance, have a sly habit of wrecking profitable oil fields by opening up new cracks and crevices hundreds of feet down in the earth and allowing the oil to escape into new pockets and pools. The skill of the geologist is of little avail in locating these hidden mysteries.

Three important factors enter into the accumulation of gas or oil beneath the earth's surface, geologists have discovered. The first is a favorable structure—anticline or monocline. The second is a good open sand, and the third the right height of structure with reference to salt water. Of these three factors only the first can be determined more or less definitely before drilling, and there is always the chance that a freakish twist or convulsion of nature has destroyed the "scent" followed by the scientist.

The development of oil field geological research dates back to the time of Dr. I. C. White, who surveyed what are known as the West Virginia, or Appalachian, fields. His reports on oil "structures" in that field have formed to a large extent the basis for investigations in all other fields. Later other pioneers took up this work in Pennsylvania and Illinois, but the Mid-Continent fields had become the country's principal producing district before this science had gained a foothold in the Southwest. Almost all of the discoveries which made Oklahoma the greatest oil producing State for a time were the result of geological investigation. The Cushing field, which will go down into history as the world's greatest oil pool unless some new record breaking discovery remains to be made, was brought in at the insistence of geologists.

Since those pioneer days commercial geologists have been turned out in large numbers to meet the demands of the oil barons of the South and Southwest. A short course for oil field geologists, patterned after the short course idea which revolutionized farming methods in the Middle West, was established some years ago by an Oklahoma college as a means of overcoming the shortage of geologists. Since then the student roll of every college specializing in this work has been carefully scanned by the great oil companies for any possible additions to their staffs.

The rewards paid geologists who have made a success of their work in the Southwest make them the country's highest paid scientists. Fees received by some of these experts have been enormous, and it is a poor geologist indeed who cannot command a salary well up in four or five figures. Oklahomans are fond of telling of the two Vandruffs, father and son, who stopped off in the Oklahoma fields at the invitation of one of the oil companies. The president of this concern was anxious to discover a new field which would enable his company to maintain its rate of production far into the future. The two experts, who had originally intended to locate in California, were sent into the wilds of a rough and hilly section of the State which had been scorned heretofore by oil men.

They spent weeks making a minute examination of the rock formations, and as rapidly as their work was completed lease men employed by the company followed them up, signing up all approved property at moderate sums. When the Vandruffs completed their investigations, this company had obtained leases on 6,000 acres of property which had been scorned by more conservative oil men. As their fee, the father and son received a one-eighth interest in the property. Some months later the first well was brought in and a prolific producing pool worth many millions of dollars had been revealed. The two disposed of their interest for $500,000, a princely sum in those days.

The rewards to be gained by oil field geologists have been by no means exhausted, and will continue to mount and grow as prospectors continue their one-sided game of hide-and-seek with Dame Nature. At the present rate of consumption America must increase her production of crude oil at the rate of more than 40,000,000 barrels a year if she is to keep pace with her own needs. In 1919 more than 400,000,000 barrels of oil were required to meet domestic needs.

## Improvements in Screw Measuring Machines

DR. P. E. SHAW, of University College, Nottingham, England, has further improved his screw-measuring machine, which has already been mentioned in these columns. The new machine appears to be very simple in construction and rapid in operation. All the movements are sliding, thus greatly reducing the time needed as compared with the tedious manipulation of the ordinary micrometer devices. One special merit claimed for the new machine is that it is equally applicable to plug and ring screws. There appears no reason to doubt that this claim is correct, in which case a distinct advance in meterology will have been secured, as the present method of measuring ring screws by means of standard plugs is not only tedious but requires a costly outlay for apparatus. The accuracy of the new machine is stated to be to 1-5,000th of an inch on diameters, and 1-20,000 on pitches, both in the case of plug and ring screws, thus satisfying the highest requirements of ordinary practice.

## Chemistry Applied to Safety

THE National Safety Council is responsible for an investigation undertaken at the Bureau of Standards to determine the action of hydrochloric acid on manila rope. When brick work is washed down, the commercial grade of hydrochloric acid known as muriatic acid is commonly employed, the men working from staging supported by manila rope used in blocks and falls. Accidents have occurred because of the rope becoming weakened through contact with the acid or its fumes, and the action takes place without any superficial trace being noticeable to the eye. Serious accidents have resulted, hence it is now suggested that the rope be treated with some acid-resisting compound. This portion of the investigation is now under way, especially with reference to ascertaining the protection which would be afforded the rope by the use of compounds which have proven effective in protecting machinery and similar equipment from acid corrosion.

## Purifying Oil by Centrifugal Action

FOR many years there has been in use in most of the large engineering works of this country a centrifugal separating machine which removes the oil from iron and steel turnings or borings, and thus permits it to be used over again. The idea which underlies this machine has now been carried further and applied to the removal of the dust and dirt which unavoidably collect in oil used in the lubricating systems of marine and other large engines. The new machine is very similar in form and operates on the same principle as the now well-known centrifugal cream separator. The foul oil is fed continuously into the machine through a strainer which catches any gross particles, precisely as milk is fed into the cream separator. The purified oil escapes continuously, while the dust and dirt collect on the inner surface of the separating drum. Provision is made by which the attendant can instantly tell when the machine is choked with the deposited impurities.

## Rotatable Coal Hopper for Locomotives

FIREMEN on big locomotives find promise of lightened work in the rotatable coal hopper that has been invented for engine tenders. This invention is so planned that the coal is kept handy at the firing deck, making it an easy matter for the firemen to reach the coal without shoveling from the rear of the tender or using power apparatus. This special hopper is in the form of a great segmental tub, or drum, having a diameter that is the approximate width of the tender. This drum is inclined toward the firing deck; it is so mounted on a ball-bearing center plate as to turn readily. In its outer wall are openings, one for each segment, through which the coal falls by gravity. As soon as the coal is emptied from the segment, the brake that controls the drum is released. Naturally the greater weight above the center of the drum makes it rotate, bringing the next loaded segment into position.

## Hunting the Dinosaur Fossils

ALBERTA was the home of many terrible reptiles and mammals now known only by polysyllabic names according to W. E. Cutler, who is excavating in the Red Deer valley for prehistoric remains. He has been digging up the skeleton of a Ceratopsian (Horned Dinosaur), and has located the whole of one side and the skull. He has also obtained a fine skull of the Stereocephalus Tetus (the Armored Dinosaur), with massive plates of bone imbedded in the skin, some of the plates being an inch in thickness. Recently too he found the fossilized skeleton of a Hadrosaur or duck-billed dinosaur.

Two dinosaur beds are located in Alberta, the Edmonton beds of the later period on the Upper Red Deer River near Drumheller, the coal town, and the Belly River beds commencing at Steveville and extending twenty miles downstream on the Red Deer. The species—although a few are common to both beds—are separated by a layer of 800 feet of marine deposits which contain remains of marine creatures.

In those early days figs grew in Alberta but the land area in western Canada was small, a central ocean dividing the solid earth from the Peace River to Central America with a coast line near Field and Banff and high mountainous country to the west. Mr. Cutler believes that the silt in which the prehistoric monsters' remains are found came from this mountainous district.

He reports that it is becoming increasingly difficult to get good specimens and he advises Alberta to get some and store them until it has the proper facilities to display them. At the same time he thinks it would be a mistake to place an embargo on the export of specimens by Barnum Brown and other American explorers.

## Zinc Manganese Alloy

IT is claimed that a satisfactory substitute for copper, bronze, and brass has been devised by adding not more than four per cent of manganese to zinc. The resulting metal is claimed to be about twice as hard as zinc and to have far greater resistance to impact. It is said to be possible to forge the new alloy when warm and also to stamp and roll it.

## Research Scores

A LARGE body of ore discovered during development work in search of gold-bearing material was found to yield about $3 worth of gold and silver per ton, which, notwithstanding a low cost for concentration, was entirely unattractive. The problem was put before a group of research men who have found that besides recovering the precious metals the material can be made to yield per ton $20 worth of white sulfur and another $20 worth of paint pigment, for both of which products there is an active demand within a reasonable freight distance. The cost of the entire operation is such that more than $35 net per ton can be realized from a material that a few years ago would have been discarded as not worth working.

## Sound Records

A PROCESS for producing sound records has been patented in which a fine modeling clay is substituted for the usual wax base materials employed for recording sounds. When the record is made the clay is dried so that the exact character of impression made by the recording needle is retained. The disk is then fired in a pottery kiln and a metal matrix from which records for sale are made in the usual manner, is prepared from this pottery disk. It is also claimed that plaster of Paris or other cement just about to set may be employed.

## Japan as a Buyer of Copper

ONE of the surprises of the year just past has been the rôle played by the Japanese in the American copper market. On every recession in values, buying by such interests has been an important factor and comment as to the object behind it has been general. The magnitude of this annual movement may be appreciated by the fact that last September the copper exports to Japan were nearly 60 times what they were in the ten years ended with December 31, 1918, while for the ten months ended with October, 1919, Japan is credited with 63,100,000 pounds or over 140 times as much as for the ten-year period referred to. Japanese buying of zinc, while not so striking as in copper, has also been heavy.

In other years Japan has exported about half of her own copper output. It is therefore surprising that she should have made such a complete reversal of policy. This may be partly explained by the statement that Japan's production of copper has decreased and her consumption increased. But there is something more than this.

Japanese manufacturers and laborers have learned how to produce in mass and the country has undoubtedly started on an era of great industrial expansion. One view of the situation is that because Japan had a thorough training in munition work, this expansion is making its first appearance in brass making. Japanese merchants are said to have discovered that Germany had prior to the war an extensive export trade to the Far East and to South America. To capture this may be one explanation of the recent buying of copper.

Whether or not, as not a few think, this heavy buying of metals and other materials portend the existence of a Germany of the Far East, it is certain that it means that Japan with her cheap labor and great imitative power, will be or already is a most important factor in the world's international trade.

## A Marsupial Rhinoceros

AS the result of an examination of a nearly complete skeleton of the extinct marsupial Nototherium Mitchelli, hitherto known only from fragmentary remains, found near Smithton (Tasmania) this year, Messrs. H. H. Scott and Clive Lord have come to the conclusion that the Nototherium was a marsupial rhinoceros. The structure and shape of the horn are matters for conjecture as no remains of it have been found but the specially constructed cervical vertebrae, the structure of the nasal regions and the curious nasal cartilage—all point to the conclusion that the animal possessed a rhinoceros-like horn. If so it is a curious case of parallel evolution for the true rhinoceros belongs to a different and "higher" group than the marsupials, none of which at the present day possesses anything remotely resembling horns, nasal or otherwise.

## Tuna Fish Oil

ACCORDING to a circular issued by the Paint Manufacturers Association excellent results have been obtained with tuna fish oil indicating that this product can be utilized, in whatever quantity produced, by the paint industry. Comparative drying tests have shown that tuna fish oil dries more rapidly than most grades of raw linseed oil. The gravity, iodine number and saponification value of the oil are similar to the constants of linseed oil, while the high iodine value, 184, is of unusual interest since it is actually higher than that of most linseed oils.

Yellow tail fish oil is another product supplied by the Bureau of Fisheries for these tests. It gives results almost as satisfactory as linseed oil.

## Improvement in Cement Manufacture

A UNITED STATES patent has been granted covering what is claimed to be an improvement in the wet process for manufacturing Portland cement. It frequently happens that the slurry sets to such an extent as to prevent its efficient handling in the usual apparatus. The object of the invention is to provide a setting preventive which will facilitate the use of the wet process and subsequently be destroyed in the kiln. One quarter of one per cent of sugar has been found satisfactory, since it prevents setting in the slurry and is of course eliminated during the clinker operation. Molasses, oxyacids, oxy-aldehydes, and oxy-ketones are examples of other suitable materials.

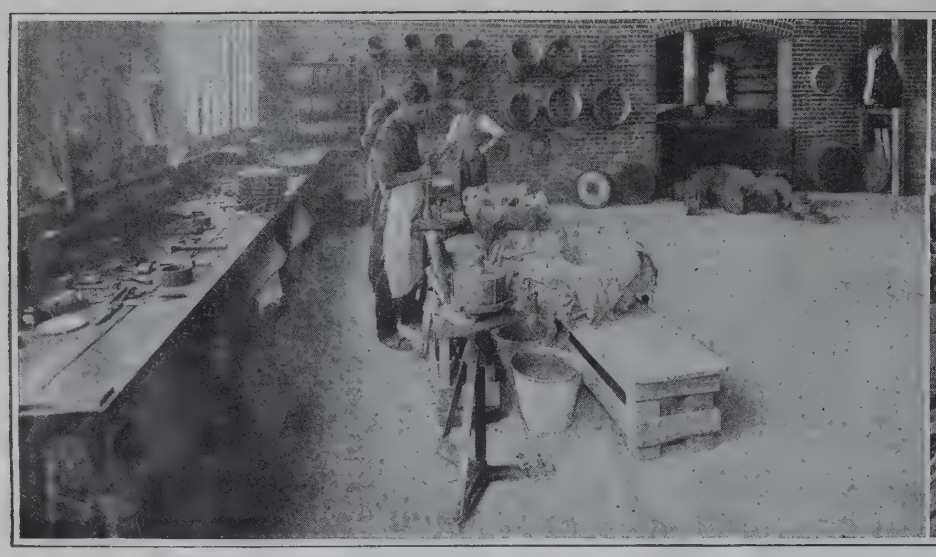
## American Potash

IT may be well to again remind those who have looked forward to the purchase of cheap German materials that times have changed throughout the world. German potash is now being quoted to the German farmer at from $2.70 to $3 per unit for the same material which formerly was sold to the American farmer, transportation paid, at 60 cents per unit wholesale. Now, on this basis the American bill for German potash used in agriculture, calculated on the imports of ten years ago, would be 75 millions in place of 15 millions as formerly.

In view of these facts, we should be very slow in discarding the beginnings that have been made toward supplying potash to American farmers from American sources. As it is now, the American industry has been discouraged and under the conditions prevailing abroad we can expect little from the old sources for some time to come. The situation as it now is was outlined by J. W. Turrentine during the recent meeting of the American Chemical Society.

## Raising a Train Shed

THE Delaware, Lackawanna & Western Railroad has nearly completed a project of raising to its original level its Hoboken, N. J., station train shed, the supporting columns of which had sunk irregularly from 5 to as much as 14 or 17 inches in places. This shed is the first ever built of the Bush type with slots for the locomotive smoke stacks. It is 360 feet wide and 630 feet long, covers 14 tracks and an area of about 5 acres and weighs 18,000,000 pounds. It is supported on 207 cast steel columns each set on a concrete foundation resting on 80-foot wooden piles which had settled. The shed was raised in 4 sections by means of jacks at each column in the station to bring the roof to its proper level. The concrete platforms have also been built up and the tracks raised to their original level. The old scheme of wire-glass roofing with large sections of glass which used to break from the vibration has been replaced by a concrete and vault light roofing. The whole project has been carried out without delay to a traffic of 225 trains daily or without inconvenience to the 1,500,000 passengers who use the station monthly.



Making silicate grinding wheels

Finishing room where wheels are trued up

# The Toolmaker's Tools

## The Modern Art of Grinding, and How the Wheels That It Uses are Made

By W. F. Sutherland

WHEN man first learned the art of working bronze and later iron he no doubt cast around for some suitable stone on which to give the finished tool or weapon a keener edge. Later on after the invention of the wheel and axle the fashioning of a gritty stone to a circular shape and its mounting on a circular axle came as a matter of course, but while other mechanical processes have undergone continual change and betterment the art of grinding has remained, until a few short years ago, much the same throughout the ages.

Today precision grinding is perhaps the most important machine shop process, for without it the automobile, the airplane engine and countless other standardized mechanisms would be impossible. Together with the accuracy possible with the modern grinding machine goes the usefulness in general of the abrasive wheel for rougher operations and in the combination of these two functions is found an instrument, without which modern industry would almost cease to function.

This is all the more remarkable since it can be safely said that modern grinding practice is hardly more than twenty-five years old. The modern abrasive wheel has kept pace with the development of grinding machinery and the increasing number of fields in which grinding finds a high degree of usefulness. The development of artificial abrasives and the care now used in incorporating them into the finished wheel have given the user a wide range of wheels with which he can grind anything from rubber to the hardest steel.

Aside from the natural grit stones found in every part of the world, emery has perhaps been in use for the longest time. Emery occurs as a granular or massive dark colored rock having much the same appearance as iron ore. It is usually associated with the oxides of iron and in addition to these sometimes contains quartz, mica, tourmaline, etc. Indeed emery may be regarded as a rock rather than a definite mineral species.

The chief sources of emery are found in the old world, the island of Naxos having important deposits which have been worked from a remote period. Turkey contains large deposits and the island of Madagascar also has some emery. Emery is also found in several localities in the United States.

Emery is only a very impure form of corundum, a mineral composed of alumina ($Al_2O_3$) and which forms in some of its finer varieties valuable gem stones. The finely colored transparent varieties include such varieties as the ruby and sapphire, while the impurer and granular forms are known as emery. The term corundum is now more or less restricted to the remaining varieties which while they have a crystalline structure are not of value for ornamental purposes through their poor appearance.

It is these latter varieties which make a valuable abrasive and corundum, under various trade names, forms the basic material of one large branch of abrasive wheel manufacture. The corundum used is either mined or produced artificially in the electric furnace, the latter becoming more and more the source of supply.

The largest deposits of natural corundum as distinct from emery are found in the province of Ontario. Three distinct outcrops have been observed, one of them being about 103 miles long by about 6 miles wide at its widest point. The corundum is found scattered through the rock in the form of six-sided prisms, sometimes of considerable size.

While alumina is generally conceded to be the third most important constituent of the earth's crust, being only outclassed by silica and oxygen, its occurrence in crystalline form is not so widespread as one might suppose. Corundum however is by no means a rare mineral, recent explorations and examinations having revealed important areas of corundum-bearing rocks throughout the world.

It is generally conceded that man cannot equal Nature's handiwork in many particulars, such as painting the lily, but while this is true it is given to him to rival her in other respects. Such is the case when it comes to abrasives, and not only is it possible to produce artificially a corundum having more desirable properties than the natural but it is also possible to produce another abrasive of an entirely different nature not found anywhere in a natural state. This latter product is carborundum, a compound of carbon and silicon. Both the artificial corundum and carborundum are produced by the same means in the electric furnace.

In the making of artificial corundum, bauxite ore is used, the same substance from which aluminum is won, but of slightly lower alumina content. In appearance not unlike ordinary clay, it differs from it in the much higher content of alumina present, that used for abrasive manufacture having a representative analysis of about as follows: alumina, 55 per cent; silica, 8 per cent; ferric oxide, 4 per cent; and titanium oxide, 1½ per cent. The bauxite used in the manufacture of abrasives at Niagara Falls is obtained in Georgia, Alabama, Arkansas and Tennessee. Large deposits are also found in France and British Guiana.

The major portion of the bauxite used in American industries comes from Little Rock, Arkansas, where open pit mining is carried on and steam shovels load the material into cars for transportation or calcining. As bauxite contains combined water, this has to be driven off before it can be used for aluminum or abrasive manufacture. The aluminum companies calcine the ore before shipment while it is the practice of the other companies to calcine at the furnace plant.

All the companies manufacturing aluminous abrasives have their furnace plants located within a few miles of Niagara Falls on either the Canadian or American side. Cheap power in large quantities is a necessity for electrothermic work and the advantage of the Niagara District in this respect is clearly shown by the number and variety of the industries located there.

While the use of the electric furnace in the production of corundum is necessitated primarily to crystallize the alumina, it also performs certain other functions and enables chemical reactions to be carried on which free the raw material from the silica and other impurities present.

It will be noticed from the analysis given above that considerable silica with some iron and titanium oxides are present in the crude bauxite. Since the product desired is crystalline alumina, these must be removed and for this purpose coke and iron borings are added to the calcined bauxite before it is furnaced. In the reactions which take place, the silica, together with any iron and titanium oxides which are present, is reduced and forms an alloy with the iron which has been added. The result is ferro-silicon of about 11 to 20 per cent grade and this is a valuable by-product, especially so during the period of the war.

The kilns in which vitrified wheels are fired

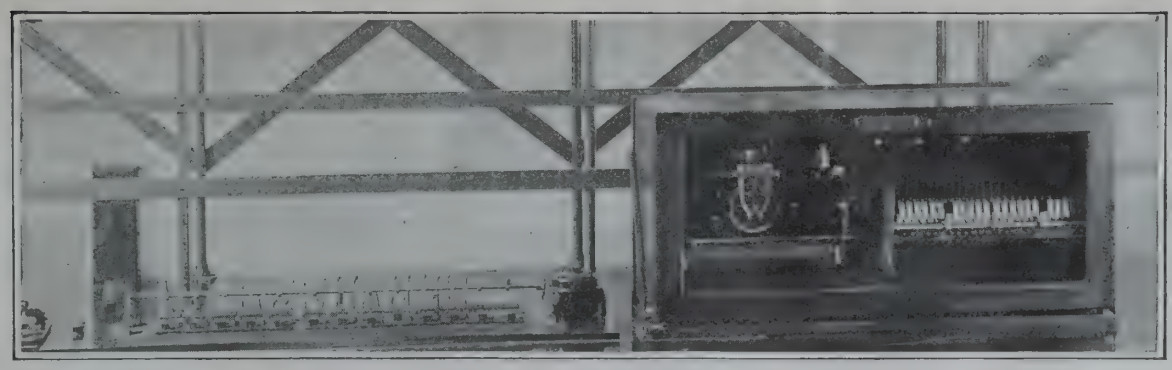
Pit-type furnaces are used as will be seen from the accompanying illustrations. The furnace consists of a refractory bottom and the four side walls of brick, mounted on a steel truck. These sides never come into contact with the molten alumina, as it is so refractory that it forms its own furnace lining. The carbon electrodes hung on supporting gear are moved up and down automatically by electric control in such a manner as to keep the current which flows through them and the bath at a proper value.

The charge is fed in gradually and at the end of about 30 hours' operation the furnace is full of an intensely hot fluid mass. The alumina floats on top while

(*Continued on page 312*)

## Gas Control by Machine

AN extremely sensitive apparatus for the automatic control of the nitrate plant at Muscle Shoals, Alabama, has been developed by the Bureau of Standards. The principle of operation is radically different from the workings of former mechanisms designed for similar uses, inasmuch as a single unit has never before been applied to so wide a variety of gas mixtures.



**The wires shown at the left, together with the recording device at the right, analyze and record twelve different gases at intervals of one minute without attention**

The device has the capacity of recording twelve different analyses successively at intervals of one minute, repeating the cycle automatically. It can determine the analysis of carbon monoxide, hydrogen, nitrogen, carbon dioxide, ammonia and various other gas mixtures. Seven different combinations can be unlocked by this apparatus, including interpretation of flue gases, mine oil, blast-furnace gases, and many industrial gases.

The operation of the instrument depends upon the conductivity of heat through the gases. The wires stretched in the axis of tubes placed in the thermostat are heated electrically. The temperature contained by such a wire depends upon the heat conductivity of the gas, which varies with the composition of the gas. By comparing the electrical resistance of two such wires, exposed to different gases, the composition of several classes of gas mixtures can be revealed. This comparison is made automatically by means of the recording wheatstone bridge shown at the right of the photograph.

The unwieldy frame shown in the accompanying illustration is not essentially a part of the automatic gas analysis apparatus itself, the framework being originally planned to support some auxiliary equipment which is not an integral part of the particular machine being discussed. The outfit can be conveyed from one part of the laboratory to another by a single individual. Similar mechanisms are to be installed in the helium plants at Petrolia, Texas, and at the hydrogen plant, Langley Field, Virginia.

## How Uncle Sam Liquefies Hydrogen and Then Bottles It

IF the seemingly extravagant claim of an Italian scientist, that one gallon of liquid hydrogen is sufficient to propel an automobile for 250 miles is borne out in practice, hydrogen liquefiers may become of common usage in the not remote future. As it is, however, the Low Temperature Section of the National Bureau of Standards has designed and installed the first hydrogen liquefier in service in the United States.

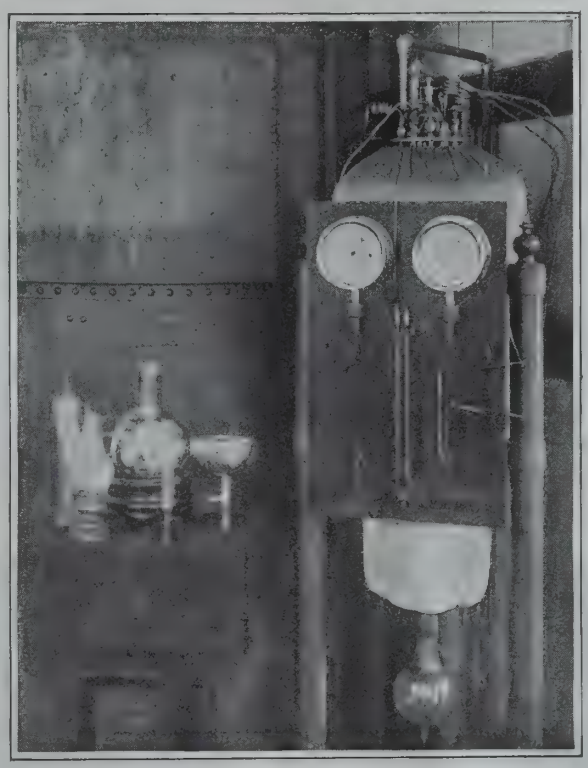
The apparatus, shown at the right in the foreground of the accompanying illustration, admits hydrogen at a pressure up to 2,500 pounds to the square inch. First, it is cooled by liquid air at atmospheric pressure, say, a temperature of approximately 190 degrees Centigrade; then by liquid air at reduced pressure, which produces a lower temperature, and ultimately by its own expansion through a valve. According to this fashion, the boiling point (252.6 degrees Centigrade) is obtained, a portion of the hydrogen is transformed into a liquid state, and is collected in the Dewar vessel located at the bottom of the liquefier.

The cold hydrogen, not converted into a liquid, serves the purpose of cooling the incoming compressed gas, and then returning to the gas holder. Liquid air used for this purpose is produced by the expansion of compressed air within the same apparatus. Solid hydrogen is manufactured by cooling liquid hydrogen, being evaporated under reduced pressure.

Situated on a stand at the left in the photograph is a group of Dewar vessels for holding liquefied gases. The glass containers have two or more walls with the space between highly evacuated as a way of minimizing air conduction, and are usually silvered to diminish the transfer of heat by radiation. The apparatus, in toto, lends speculative interest to the announced discovery of the chemist in Italy, who claims to have found a method of cheaply producing liquid hydrogen.

## Improvements in Cast Iron Wheels

FOR the railroad-material industry, the Bureau of Standards has worked out a number of important problems. It has completed an investigation of the graphitization of white cast iron upon annealing. This problem arose in connection with other investigations of the properties and characteristics of chilled-iron car wheels and in particular the best range of annealing temperatures. This was brought to the attention of the Bureau by one of the car-wheel manufacturers. The



**Hydrogen liquefying device at right and collection of Dewar containers at the left**

composition is so chosen and the wheel is so cast that the tread and inside of the flange show white iron and the remainder graphitized or gray iron. In order to relieve the stresses set up during the cooling of the wheel under drastic conditions, the wheels are piled in pits while red hot and allowed to cool very slowly. Investigation developed that the highest temperature at which no graphitization of the tread and flanges takes place is about 700 degrees Centigrade, which is also the maximum annealing temperature for car wheels.

The investigation of stresses in chilled-iron car wheels caused by heat from brake action has been nearly completed, says the Bureau report. A very large percentage of car-wheel failures are attributed to stresses caused by heating of the tread by brake action, the central part or hub of the wheel remaining relatively cool. It is the purpose of the investigation to determine and record for adoption the most suitable material and design of wheels to resist stresses of this kind. In this investigation the tread of the wheel is heated by passing an electric current through a circular resistor insulated from the tread. The wheel remains stationary, thus readily permitting the taking of the temperature and strain-gage readings. Considerable differences have been found in the behavior of wheels differing in design and weight.

## Technical Sponges

A SPONGE can be briefly defined as the skeleton of certain aquatic animals—naturally there are a number of varieties. This skeleton while being fairly strong when first used, gradually softens and breaks down through use and bacterial action. A patent for a tanning process has recently been issued to W. H. Allen of Detroit whereby the strength of the sponge is greatly increased and also increased resistance to bacterial action. The sponge is chemically in the same class of material as hides. It is to be inferred there is a good fortune for the tanned sponge.

## Domestic Hot Water by Electricity

A SYSTEM of domestic hot water supply by electricity, introduced by a British electric company, depends on the use of a tank with an electrical heating device which is kept always in circuit. As the consumption of current by each size of tank is known and constant, there is no need for a separate meter, and on the assumption that the electricity supply undertakings will grant a special low rate for the heating current the amount payable can be found by subtracting this known consumption from the total shown by the meter, the residue being charged at the ordinary lighting rate. The smallest sized tank made takes 150 watts (328 units per quarter of 13 weeks), and is designed to give a daily supply of 10 gallons of water at 150 degrees Fahrenheit, which is reckoned to be sufficient for the domestic needs, apart from baths, of a household of five. For baths it is suggested that the bath room tanks should be fitted with a supplementary heater, to be switched on when extra baths are required, the current it consumes being paid for at the lighting rate. The company disputes the statement that electricity cannot be used economically to heat water, as compared with coal, coke, or gas; it asserts that it is true only in the case of small vessels or a pipe system having large surface area in proportion to cubic capacity, and not in the least true in the case of a large cylinder so designed as to have minimum surface area and a continuous operating temperature well below the boiling point.

## What Is the Lamp's Candle-power?

THE double precision photometer shown in the accompanying illustration is used by the U. S. Bureau of Standards in keeping check with the international candle as maintained by incandescent lamp standards. The apparatus is the final judge for lamps used by the various Government departments as well as private interests that may apply such standards of quality.

Two observers operate the instrument, the lamp stationed upright in the middle of the apparatus being the basis for applied measurement. Simultaneous observations are taken by the two observers with the test lamps. Electrical instruments and adjusting resistances are shown on the bench at the right of the photograph. Records are stamped electrically on the recording drums, one of which is shown at the center of the illustration.

**The Bureau of Standards determines the candlepower of electric lamps by means of this double precision photometer**

# Solving the Labor Problem—I

## The Development of an Industrial Policy of Mutual Interest Between Employer and Employee

By George M. Verity, President, American Rolling Mill Company

*WITH all the strikes and other disturbances involving those who own and those who use the means of production, it is evident that we are living in an age of industrial readjustment. At the same time, in spite of the conflict between apparently irreconcilable extremes, it is beginning to look as though we were really making progress toward a definite solution. It is of the greatest importance in such a time as this to have it forcefully brought home to us that adjustment of the contradictory demands of capital and labor is possible, that it does not necessarily involve either sacrifice of the general outlines of the present capitalistic system or on the other hand a continuation of the unreasoned subservience of labor's interests to capital's whims—in short, that at the present time and in many places a middle ground has been found and a process worked out whereby capital and labor can really work side by side in harmony and good understanding. The* SCIENTIFIC AMERICAN, *in order to contribute to the circulation of this idea, has asked high executives, in plants where cordial relations between the owners and the workers prevail, to write their own stories of how these relations have been brought about. Mr. Verity's story is the first of a series which will include articles by numerous other gentlemen of similar standing to his, the general tenor of which will be to show that the two branches of the industrial community really can live in the same house. We think that this series will be found to contain documents of real human interest, and of very material value in the promulgation of right ideas on the industrial situation.*—THE EDITOR.

IN the early days of the steel industry in the United States and leading up to some twenty-five years ago, there seemed to be an almost universal spirit of suspicion and distrust existing between the workers and mill owners. Young men grew up in the belief that the employer could not be trusted and that any holding out of the olive branch was simply camouflage for selfishness or treachery of some kind or other.

It was the policy of the mill owner (there were more individual owners who were operators in those days than now) to hire and fire as he chose and to look on the worker generally as unreliable and untrustworthy. Coöperation in industry had not as yet been born.

That condition existed to a greater or less degree when The American Rolling Mill Company of Middletown, Ohio, began the construction of its works in the spring of 1900. Actual production was begun in the spring of 1901 with a force of some four hundred men composed of both skilled and unskilled men of the various kinds needed in the several departments of the business as then organized.

From the very beginning, the Management was impressed with the idea that real permanent success could only be attained through the hearty coöperation of all those composing the Company's working organization, that the development of the human element was the key to stability and progress. They believed that such coöperation could be secured through,

First: the adoption and the announcement of a "square deal policy," born of real mutual interest and of a desire to be fair, frank and considerate each of the needs and wishes of the other.

Second: through winning the good will and confidence of our men by consistent support of every policy announced.

Third: through visualizing to our organization from month to month the value and soundness of our policies.

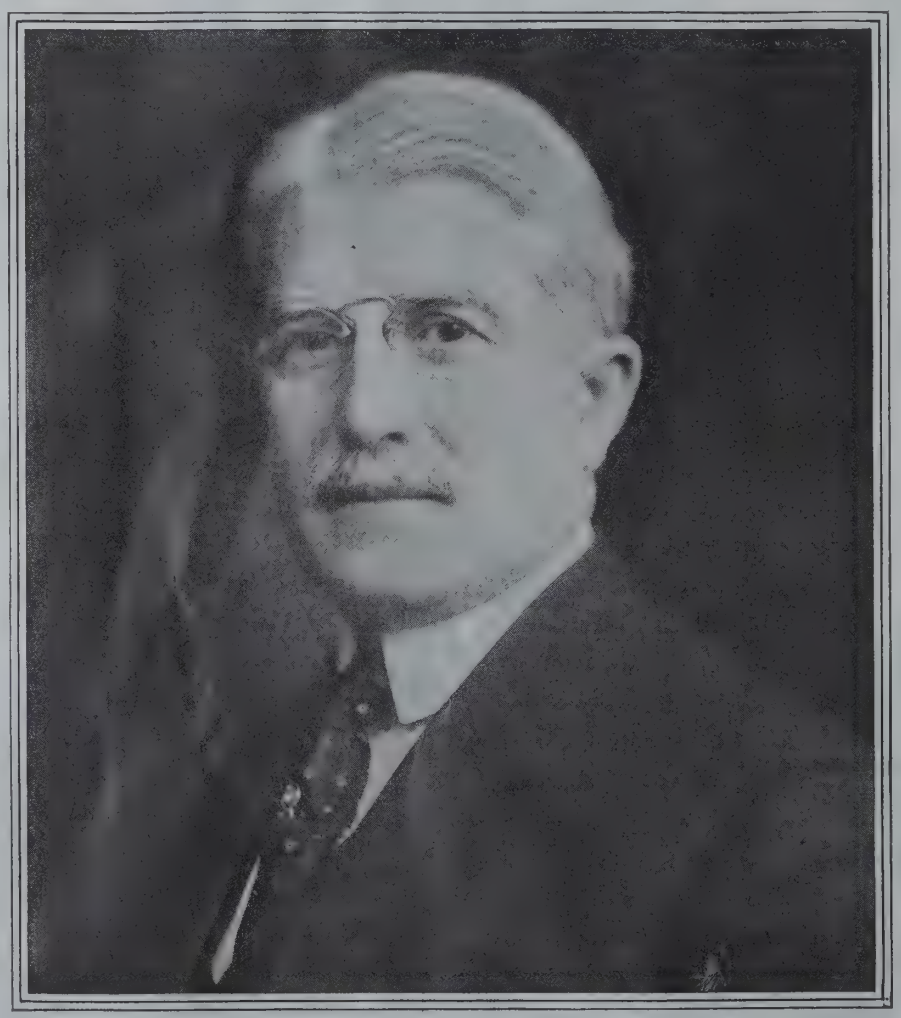
Fourth: through the realization of the fact that a Management must make good to its men just as the men must, individually and collectively, make good to their Company.

Those policies were patiently and consistently supported for a period of five years before we felt that we were entitled to any verdict from our men. At the end of that period we had substantial evidence of appreciation of the policies inaugurated, which gave us courage to make a still greater effort to win the entire confidence of our organization.

An Advisory Committee was appointed by the men in our Sheet Mill Department, which at that time comprised our largest group of workers. Any agreements or suggestions on the part of the men or the Management were put up to them for discussion and consideration. They handled all matters that came before them with such impartiality and fairness that a still closer relation was established between the men and the Management.

At the end of the first ten years, the Company found it necessary to double the capacity of their works and, in so doing, a change from small-mill practice to modern big-mill practice had to be made. This brought in a large influx of new men from all over the country, men who were unfamiliar with our policies and methods of operation. The old organization suddenly became a small part of the new and so it was necessary for us to begin all over again.

While we felt that we had in a very large degree earned the confidence, the good will, and the support of our first group of men, their very belief in the Company was for a time a handicap rather than a help, as the new men felt that they must have been unduly influenced in some manner or other. This new situation, therefore, had to be handled more carefully and wisely than ever as our common interests had become much larger. But a patient, persistent application of our ideas of "a square deal," together with the substantial return that came to the men from month to month and year to year through steady operation without friction or discord, soon had its effect.



**George M. Verity, one of the men who have shown that the interests of capital and labor are not necessarily antagonistic; that these two elements can "live in the same house"**

As the new men came into the light, they began to see why the older men were friends of their Company and a further lapse of time brought them to a fuller realization of the undisputable fact that the Management and men have much in common and that by working together earnestly, diligently and efficiently more could be accomplished for all concerned than could possibly be secured under any plan of suspicion, discord, and contention.

We endeavored to show our appreciation of the good will and the confidence given us by our working organization by expanding and developing our mutual interest policies whenever and wherever possible, through providing everything we could in the way of incentive, of opportunity for progress, and in the doing of anything and everything that we could that might make life and a place in our organization worth while. "Armco" fosters no welfare work in thought or in deed, for we do not believe in it.

We say to the members of our organization—"Give us your best, your most loyal and efficient service, give us continuous and uninterrupted operation, take that sort of an interest in your individual task as you would if the business were all your own, and in return we will give you the fairest and most generous treatment and the best compensation that the result of our common effort makes possible. We will do anything and everything we can to make life and a place in our organization worth while."

That is what we call "Mutual Interest Work"—a real fifty-fifty contribution with no place or need for anything that smacks of so-called "Welfare Work" or "Philanthropy."

It has always been our conviction that industrial stability is the product of that sort of human happiness and human efficiency that is born of a spirit of confidence and of mutual interest, which is in turn the result of much practical, whole-hearted coöperation brought about by an enlarged understanding of the basic principles underlying all of the problems of a particular business, and of what a real pull-together can do for all concerned.

Wherever human beings are brought together in a common undertaking, there is in the beginning so much of misunderstanding, such a lack of understanding that must be overcome before even a start toward the goal of stability or success can be made.

We believe in that sort of an understanding between associated groups of men that will incite the interest, the imagination, and the ambition of the individual, as that is the only way in which a real group spirit, plant spirit, or company spirit can be created and developed.

Without the influence of a real company spirit, born of mutual interest and understanding, no great accomplishment can be made or perpetuated.

Under our mutual interest policies, there has developed in our organization a strong, constructive, indestructible plant spirit which we term "Armco Spirit" and which has gradually defined itself as follows:

"This spirit is a comprehensive, vital force which finds expression in the practical application of policies builded on a platform of Christian principles, in which selfish purpose has no place.

"This spirit combines in proper proportion a spirit of fairness, a square deal always, both in theory and practice; a big, broad view of every problem, cutting out all narrowness and littleness; a spirit of unselfishness, of loyalty, of

(*Continued on page 313*)

## Taking the Pricks Out of the Prickly Pear

A NEW use has been found for the juicy pear—the prickly variety—and you can well envy the cattle of Texas and other States of the Great Southwest that enjoy such a choice ration. Although this variety of fruit differs from the common pear, its growth being restricted to the desert, it belongs to the big fruit family which name it bears.

Machine used for chopping prickly pears so as to shatter the spines and fit them for stock feed

The prickly pear, as its description implies, is covered with spiny thorns which should be removed before cattle partake of the fruit. An ingenious method of removing the spiny growth, as shown in an accompanying photograph, is to singe the plants with a gasoline torch. The artificial treatment thus burns the tiny thorns and the cows can graze with impunity. Otherwise there is danger of the animal suffering from lodgment of a spine in the throat.

Another method of utilizing this desert plant, which proves a valuable emergency ration during the period of parching aridity, is to put the unsinged prickly pears through a chopper. This merciless treatment which the material receives from passing by rapidly revolving knives is such as to shatter the spines and fits the roughage for stock feed.

The prickly pear, however, is more ideally adapted to grazing—less expense and gives better results when fed in the fresh, green state. Scientists of the U. S. Department of Agriculture, recognizing the value of the prickly pear as a stock feed, has begun experiments in Texas and California looking to its perpetuation under cultural conditions. It will thrive where the rainfall is irregular when staple crops succumb to the drought, and its yields are large and cumulative. There are two classifications of the species—the spineless and spiny varieties, each of which has its respective merits.—By *S. R. Winters.*

Applying the gasoline torch in singeing the spines from the prickly pears, so as to make them available for the cattle of the Southwest

## Some Tricks of the Motion-Picture Screen in the Making

IT seems to be quite the accepted thing among film "fans" to expect a favorite actor to climb the fronts of houses and do all manner of other daring feats. Yet if they stopped to analyze some of the "stunts" performed by their screen heroes, they would soon realize that these men could not possibly do the things they apparently do. And here is where we unearth the close alliance between property man and actor especially in comedy productions.

Your hero who climbs up the front of the house can do so in several ways without being a champion climber. In the first place, and where realism is essential, a "front" representing a house can be erected on the studio grounds, provided with ornaments which in reality, are nothing more than staggered rungs of a ladder. These ornaments make it quite a simple matter for the hero to climb or descend the house front.

Then there is another method, with even greater possibilities. That is the "front" that is laid on the studio floor while the cameras "shoot" the scene from above. The hero climbs up the front of the house by crawling on his hands and knees along the studio floor. And the same equipment makes it possible for the "human fly" effect, the dog or horse running up the side of a house, or even the automobile dashing up a wall. The work is quite harmless and simple, to be sure; but so effectively painted is the canvas laid on the floor that it is often a perfect illusion when shown on the screen.

There used to be a certain brand of comedy films which made a great name for itself because of its wonderful action. The audience was held by some bit of clever action every moment of the entire film. The acting was largely in the nature of the so-called "slap-stick" comedy, but it was perhaps the highest class of such comedy turned out until that time.

Now the performers of that brand of film did the most startling things. They smashed into walls and went through houses on motorcycles and in automobiles; they ran mile after mile at hair-raising speed; they went through the floor of one apartment and into the rooms below, along with a deluge of lumber and plaster and what not.

In this case the property man's work was apparent at every turn. In the case of those dashes through walls, the studio carpenters merely constructed a suitable scenery on the "lot," which was so arranged as to break away at any fair provocation. Thus the wooden "bricks" were built into a wall, and the various materials were lightly held together. The same applies to those scenes where performers crashed through a floor. The construction in all such scenes was of the "breaka-way" or "break-apart" variety, cleverly got up so as to make it seem quite the real thing.

Where a vehicle or a performer is shown dashing along at a high rate of speed, with the scenery flashing behind him, the effect can be secured in two ways. First, the effect may be the real thing, in which case the vehicle or performer is filmed from an automobile or motor truck moving in a parallel direction. Secondly, and most likely, it may be faked in the studio yard by means of a merry-go-round arrangement. This consists of a circular platform with suitable scenery on its inner edge, suitably mounted so that it can be revolved. Now then, with the performer or vehicle placed on the platform and with said platform in action, the vehicle or performer merely has to simulate rapid travel while the stationary camera films the subject which does not move very far from a fixed point in the range of the lens. Meanwhile the scenery flashes by at the rear in a convincing enough manner.

Where an automobile is shown riding along a road for mile after mile, the screen audience obviously traveling along with the vehicle, the effect has been produced by mounting the camera either on the car itself, such as on the hood, or on a platform extending in front of the hood, or on a separate car or motor truck in front. In the latter case the motor truck or car generally tows the automobile where fairly close-up action is to be shown, the hauling cable being hidden from the camera in some suitable manner. By hauling the automobile a definite distance is maintained between the camera and the subject, and there is no danger of a collision.

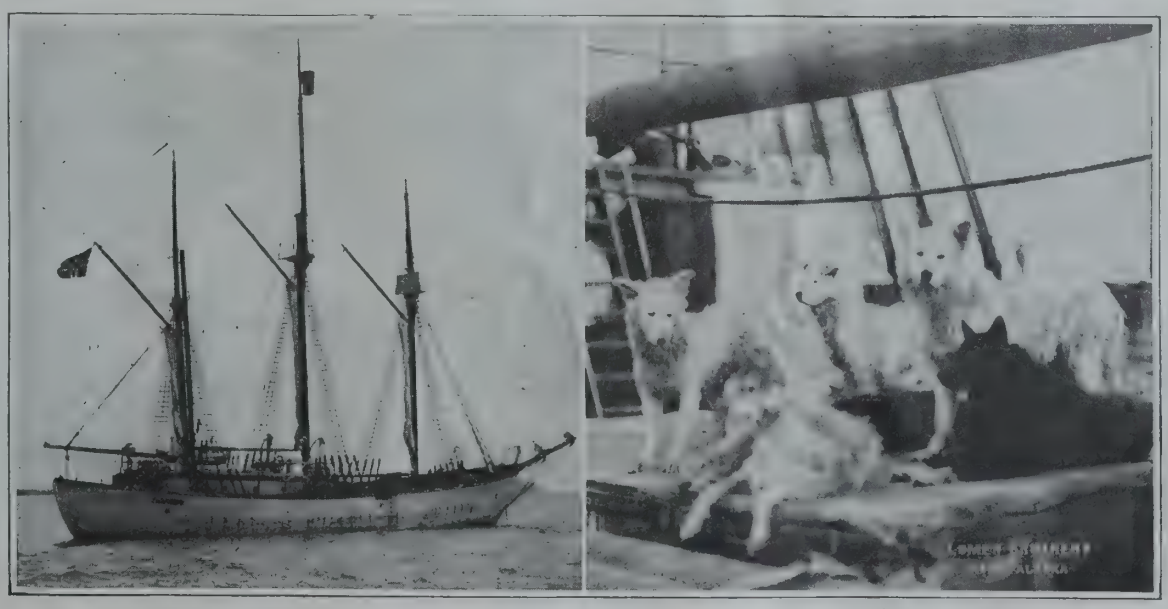
Papier maché bottles, plates, clubs and so on, hinged lamp posts, rubber prison bars—all these things are but a few of the many contributions of the property man to the film comedies. The dishes which the comedians smash on each other's faces with such apparent abandon are certainly of the breakable variety, arranged to smash at the slightest coaxing. Yet a custard pie is always a custard pie: it must be real to produce a reel laugh!

## Working the Tar Sands

NINETEEN hundred and twenty acres of tar sand rights in the Province of Alberta have been leased to General William Lindsay. The general claims that, as a result of investigation and research which has been conducted by him and his associates, a successful process has been evolved for the extraction from the tar sands, on a commercial basis, of the oil, bitumen, and other hydro-carbons they contain. The lease has been granted to permit a thorough test of the process.

## The Return of Amundsen Expedition

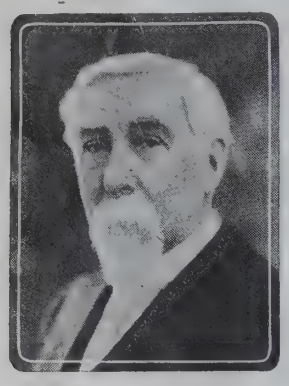
IN connection with the recent arrival of Captain Roald Amundsen in Nome, Alaska, after two years' absence in the Arctic, the accompanying photographs will be of interest. One shows the "Maud," the 900-ton ship which carried the expedition through the polar seas and safely out again. This vessel is specially designed for drifting in the ice packs, having a curious egg-shaped section which makes for its being squeezed up out of the water rather than crushed, when the ice closes in about it. The other view is of the dogs that served the explorer in such good stead in his many expeditions from the ship out over the ice pack.



The ship that carried Amundsen through the Arctic waters, and the dogs that carried him over the ice

# Henry M. Leland's own Story of

After the armistice was signed and the Lincoln Motor Co. was completing its contracts with the government for the production of Liberty Aircraft Motors, we called a conference of our engineering force. The principal members of this force are the same men who have been among the leaders in the development of Leland-built cars during the past twenty years.



*Henry M. Leland*
*President*

We have always been strong advocates of the conference idea. Nothing of vital importance, particularly to car owners, is left to the judgment of one man, no matter how competent he may be.

"Boys" I said—I still call them boys because most of them were not much more than that when they first came with us some 20 years or more ago. "Boys, you have been telling us of your ideas and we are ready for you to go ahead with them.

"You know our ideas as to quality, ruggedness and stability. You have an opportunity now such as you have never had before, to make a thoroughly roadable car, a car that will not only go anywhere but that will go there with ease to the driver and with comfort to the passengers; a car with which it will not be so necessary to pick out only the good roads, a car that will enable people to travel unfrequented highways and to go places they have not been able comfortably to go heretofore.

"Do the job as you have always been accustomed to doing, only do it better. After the experimental cars are finished, we want to figure on at least a year to prove them out, so as to leave no shortcoming for the car owner to discover."

In about six months they had designed several different types and had actually constructed two different types. They were both truly wonderful cars, but we adopted the better of the two. Four engines were built; three of them were installed in chasses and the fourth was assigned for testing on the dynamometer. That was about a year ago.

Then followed the refining process and ferreting out deficiencies. The cars have been subjected to the most severe and the most practical punishment we could prescribe and have successfully withstood endurance tests equal to about five years' service in the hands of the average user.

I believe motorists will agree that the ideal car should possess primarily, six important virtues—good appearance, trustworthiness, long-life, power, economy and comfort. The order of their importance is largely a matter of individual opinion.

## *Appearance and Stability*

In appearance, the cars are substantial, well-proportioned and graceful. There is nothing extreme or overdone in any of the eight body types—just thoroughly dignified; they are cars such as the best citizens, persons of good judgment and refined taste will be proud to own. Their beauty is a type dictated, not by passing fancy, but by a desire for permanent attractiveness. The cars are replete with those many little conveniences which contribute so much to real pleasure and enjoyment.

Those who are familiar with the accomplishments of our engineers and designers—men who have supervised the building of more than 100,000 quality motor cars—know the unusual reputation of those cars for trustworthiness, stability and long life.

These engineers and designers are still working upon the same principles but with the added advantages of greater resources than ever before, greater precision in manufacture and more suitable metal alloys than heretofore employed.

This in itself would make it reasonable to expect that the new car will possess elements of marked stability—elements which in themselves mean true economy over a period of years. And there is the added assurance that comes from the long proving-out period through which the car has been evolved.

## *The Engine*

Our new engine, which embodies a number of unique and distinctive features, but which cannot well be treated in detail here, I regard as the most efficient piece of motor car mechanism I have ever seen.

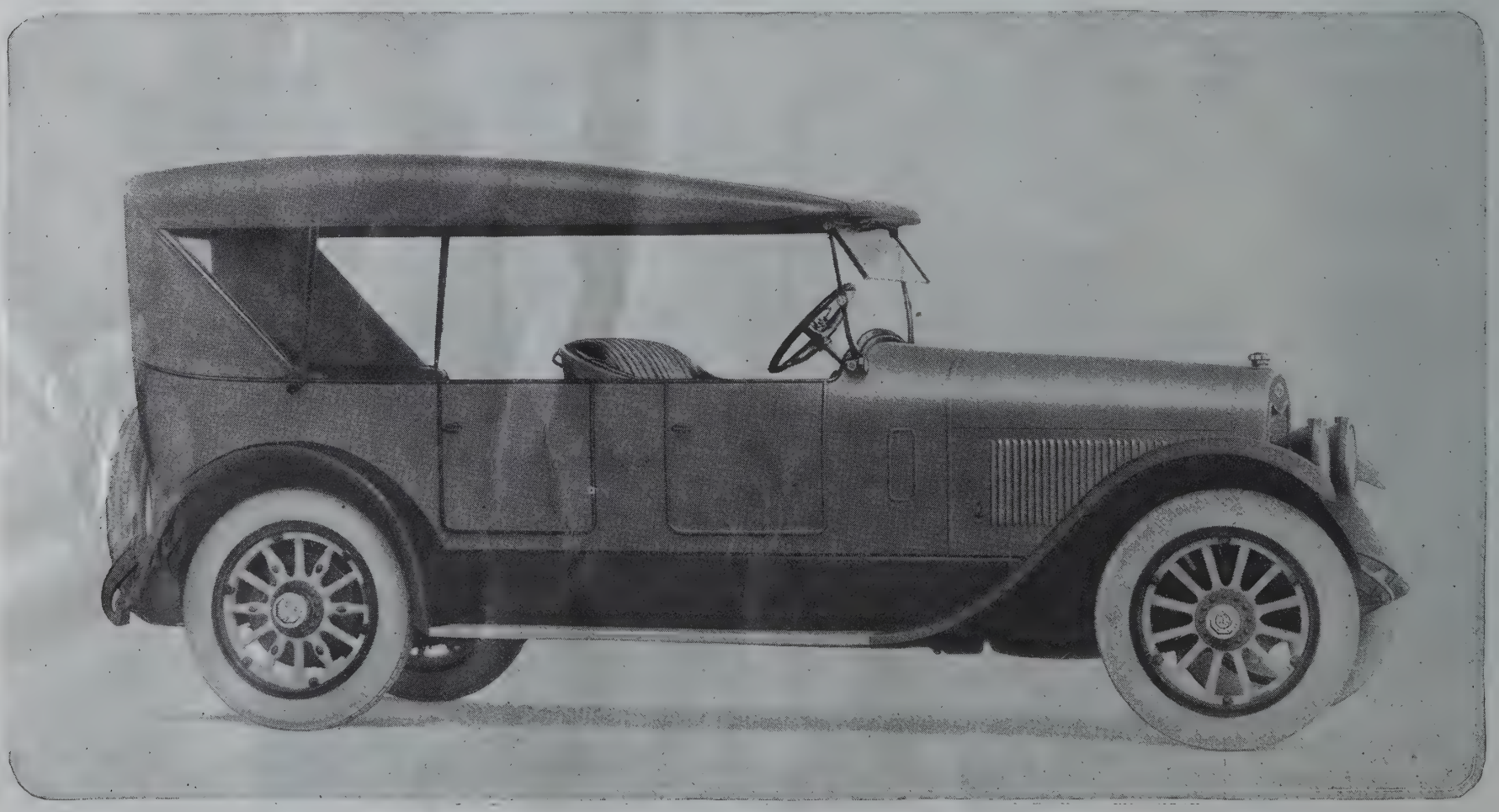
Its piston displacement is 357.8 cubic inches. Its power seems almost limitless; I can hardly conceive of any call to which this engine will not respond.

The wheelbase is 130″ except of the Limousine and Town Cars of which it is 136″. The tires are 33″ x 5″ cords.

## *Comfort and Performance*

In this day of fine cars, it is not easy to imagine a more enchanting way of abridging distance, but let me cite my own experience:—

Our engineers and experimental drivers had been telling us what an unusual car they had; but



*The Seven-Passenger Touring Car*

*(Leland-built Lincoln Cars will*

# the new Leland-built Lincoln Car

frankly, I was a little inclined to discount their enthusiasm.

However, I had occasion to go to Defiance, Ohio, some 125 miles from Detroit—according to the Blue Book. I thought here would be a good opportunity to see for myself just what the car was. There were five of us. The top was up.

We were on a fine stretch with no other vehicles or cross-roads in sight, bowling along serenely at about 40 miles per hour—*so I judged.*

I am constitutionally opposed to speeding, but my interest and curiosity, I suppose it was, got the better of me.

"Step on it and let's see what she can do," I said to Harry, the driver.

"She's doing her best now," he answered.

Doing her best at 40! I was keenly disappointed. My hopes were fast fading when Fred who sat beside the driver called back:—

"Why she's hitting 76 Mr. Leland" and laughingly, "You know this isn't an airplane with a Lincoln Liberty motor."

Perhaps I should have known better had I observed how swiftly the scenery was passing.

My hopes rose. There that car was running just as sweetly and with as little fuss and vibration and with as little apparent effort at 76 as it did at 30—and there was none you could notice at 30.

Periodic vibration, which is something that engineers have tried for years to overcome, was at last absolutely unapparent to me, *at any speed.* There seemed to be an unusual harmonizing of the various functions. And the car was so steady; it seemed to hold the road as if it were in a groove.

I might add in passing that this elimination of the vibration period was not an accidental accomplishment. On the contrary, it was achieved only after much research, experimentation and money outlay.

Elimination of engine vibration, practically to the zero point, is without question a great stride toward prolonging the life not only of the engine itself but of the entire car.

As I said before, I am opposed to speeding; but when a car is made to possess the many other essentials to a real performer—power, acceleration, facile control, etc., speed is a natural consequence. You might call it a by-product, the use of which is entirely at the option of the driver.

A little further on the trip, we came to another stretch; it was pretty rough; several miles of what you might call de-macadamized road. It was a stretch that ordinarily you would not want to take faster than at about 15 miles per hour; but at 41 we were not uncomfortable. The sensation was more like sailing in a yacht as compared to a canoe on a choppy surface.

There was a most agreeable absence of sidesway and violent bouncing—no tendency to throw the passengers up and about.

From a standstill, the car seemed to get away with the grace and ease, but with the swiftness of a thrush, rather than with the flutter of a partridge.

I believe I have ridden in or on almost every kind of conveyance, from the ox-cart to the airplane, but even with all my fond hopes and anticipations, never did I expect to ride in anything which comes so near to what I imagine would be the sensation of flying through space without mechanical means.

The prices are based upon the highest class of materials and workmanship, and upon scientific and economical manufacturing methods, made possible by tremendous preparation in labor-saving machinery, tools and devices—plus knowing how to use them.

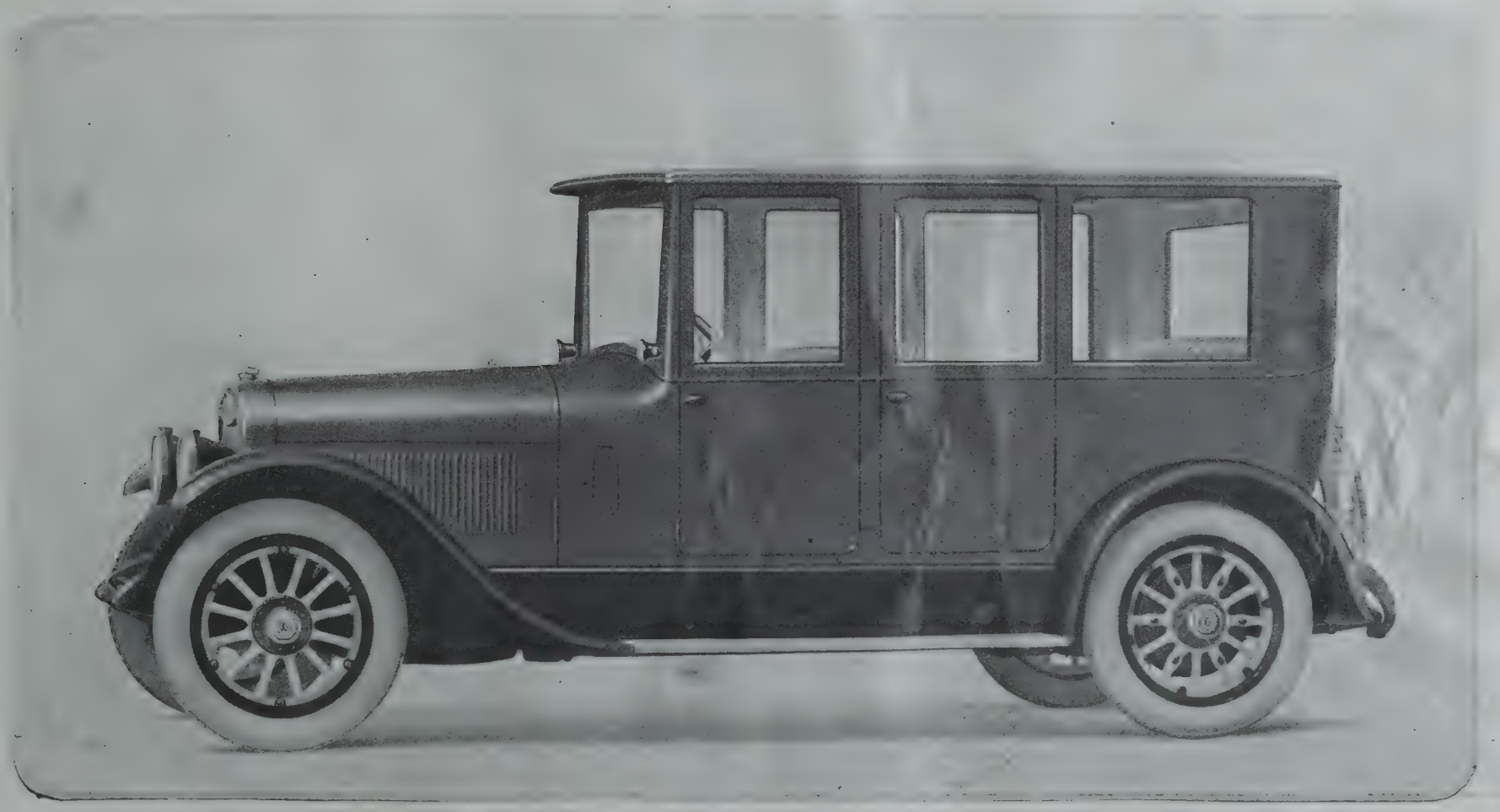
While these involve a vast initial expenditure of time and capital, they lend themselves to minimum production cost in large volume. There will be a legitimate margin of profit—no more. There will be nothing added just because we anticipate that motordom will recognize a superior car, nor because we anticipate that the car will afford a degree of satisfaction and comfort heretofore unknown.

*Wilfred C. Leland*
*Vice-Pres. and Gen. Mgr.*

We are obliged to send this story to the publishers some weeks in advance of its appearance. It is expected that cars will be in the hands of Distributors by the date of this publication. Should something unavoidable occur, there may be a little delay in deliveries, but we can foresee nothing now.

I have tried not to be over-enthusiastic but the car *really is* such an innovation that it is not easy to exercise restraint, and I feel confident that your own observations of the car and its performance will abundantly confirm my own impressions.

Henry M. Leland
*President Lincoln Motor Co.*
*Detroit, Mich.*



*be available in eight body types*)

*The Five-Passenger Sedan*

# Reconstructing Stonehenge

## Work of Preservation That May Solve the Origin of Britain's Most Mysterious Ruin

By Harold J. Shepstone, F.R.G.S.

STONEHENGE, Britain's oldest and most mysterious ruin, is in the hands of the builders. Powerful cranes and the latest modern lifting appliances have invaded its sacred precincts and gradually the work of restoring the monument to something of its former grandeur is being carried out.

General view of the operations at Stonehenge

It was just before the armistice that the strange conglomeration of stones which adorn one of the ridges on Salisbury Plain passed to the nation, and now belongs to the British people. The restoration work is being carried out by the Office of Works, under the direction of Sir Frank Baines, a well-known architect. He is being assisted in the task by the British Society of Antiquarians, who are hoping as a result of the excavations which are being made on the site to learn something of the origin of this strange pile of stones. That has always been the riddle of Stonehenge. Who built it? When was it reared? And for what purpose was it conceived?

Although no one has satisfactorily answered these questions it is nevertheless possible to tell how it originally appeared, despite the fact that many of the stones have fallen, while not a few have entirely disappeared. Some of the smaller ones have been carted away by unscrupulous persons and used in the building of local bridges and other structures. Others again have been broken, and will require special treatment if they are to be used again.

One cannot view the remains of Stonehenge today without marveling at the ingenuity of those early Britons. When it is remembered that it was probably built between 3,500 and 4,000 years ago, that some of the stones turn the scale at 30 and 40 tons apiece, it is clear that it represented in its age a great and momentous undertaking. It is a complicated structure of earthworks, of stones arranged in circles, of stones arranged in horseshoe fashion, and of other isolated stones, and earthen barrows.

First came a long avenue, running from northeast to southwest, defended by ditches on both sides. This leads to a circular earthwork about a hundred yards across. Within this stands the real Stonehenge. First came an outer circle of what archaeologists technically call trilithons; that is, two stones planted upright, side by side like two posts of a door, with a third placed across in the fashion of a lintel. There were thirty of these piers in all, and with their imposts they formed a corona or ring of stones at a height of about sixteen feet from the ground. Within this outer wall, and almost forming a lining to it, stands a smaller circle of stones of which only a few remain. Within these two circles again come two horse-shoe erections in the form of huge trilithons.

Besides these regular structures there are scattered remains. A single stone, called the Sun Stone, lies in the avenue and on the axis of the horse-shoe. It has been so christened because it stands just where any one inside the horse-shoe would see the morning sun at mid-summer appear above the horizon. On it the first rays of the sun would fall, and therefore it is the Sun Stone. Inside the circle two large stones lie prone, respectively called the Alter and the Slaughter Stones.

The work of restoration is being carried out in a most thorough and systematic manner. First a minute survey was made of each stone and the smallest crack or crevice on any one of them noted. These cracks are being left for the present. They will be attended to later, the question of the moment being how to save the stones without doing anything to spoil or alter their looks. After the survey the stones were numbered, a powerful crane erected, and the work of actual reconstruction put in hand.

Attention was first paid to one of the trilithons whose pillars were leaning at a dangerous angle. The lintel, the impost across the top which turned the scale at five tons, was first carefully enclosed in timber baulks and thick layers of felt so that it would not be damaged in any way. It was then lifted by the crane and lowered carefully to the ground. In order that the two pillars should not be damaged they, like the lintel, were protected by timber baulks and felt. Never was the most precious of babies more carefully wrapped up than is one of the monoliths before the jacks which force it into its rightful position are set to work. Not only is it cradled in thick baulks of timber, but every cranny is filled up and padded with felt and wedges and the whole framework is again supported by struts and steel joists.

It is necessary now to lay bare the base and make a new bed for the monolith. The ground round the pillar is outlined into squares of twelve inches. Inside these squares the earth is taken out to a depth of six inches at a time and passed through a sieve. The object here is to salve any object which would throw light upon the actual origin of the monument. A Roman coin, numerous stone implements, and wooden stakes driven into the earth for the purpose, presumably, of keeping the stones upright, have been excavated. It has been found that these huge pillars which stand 21 feet above the ground and weigh between 30 and 40 tons apiece were usually set in the earth to a depth of only three or four feet. With such crude foundations it is wonderful how well the stones have stood.

As soon as the base of the pillar is laid bare the work of moving it back into a perpendicular position is

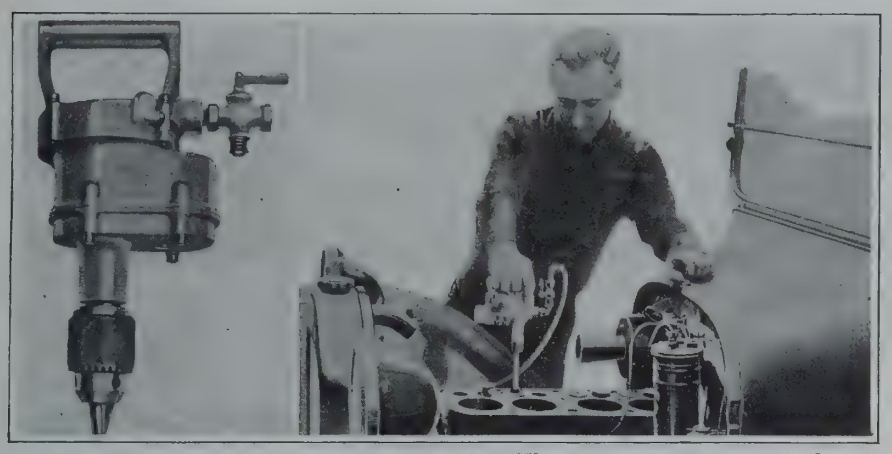
(*Continued on page 314*)

*Left:* Ready for concreting the base. The monolith, still encased in lumber, has already been jacked into position. *Right:* Preparing to lift one of the lintels.

**Some details of the work being undertaken on the Stonehenge monuments**

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*



**Two pneumatic tools for garage work: The pneumatic drill and the pneumatic valve-grinder**

## Putting Air Pressure to Work in the Garage

TWO interesting devices which can be operated on the ordinary garage air tank have been perfected by a Michigan manufacturer. A pneumatic drill weighing 7¼ pounds and a pneumatic valve grinder are the latest developments for the garage mechanic's use.

The drill is capable of being used in close quarters and is particularly serviceable for fender and frame work of all kinds. The device has throttle control permitting proper drilling speeds for various sizes of drills and adaptability to different materials. The motor is of the turbine type and the entire mechanism is enclosed in a dirt-proof casing.

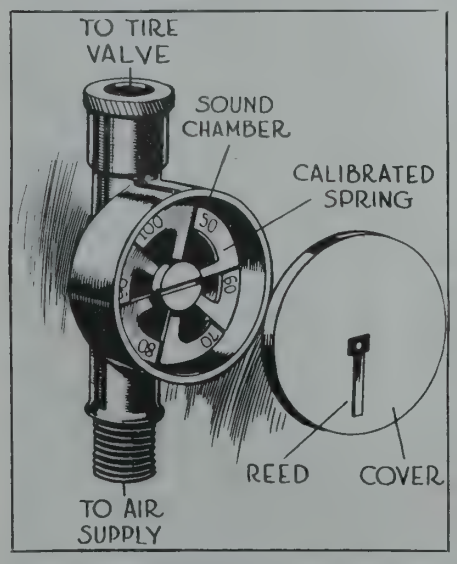
Due to uniform oscillation the valve grinder grinds a more perfect seat than may be obtained by hand drilling. The speed is always under the control of the operator and may be varied from 150 to 1,000 strokes per minute. The grinder is found useful in grinding valves in inaccessible cylinders in various types of motors. All working parts are encased in an aluminum alloy and thus grease, dirt and grinding compound are prevented from getting into the working parts.

## When Rusted Parts Must be Pried Apart

AN automobile mechanic ought to know better than to lose what temper he may have when attempting to remove machine parts which are badly rusted in. This new device will help him cure his distemper, for it is made specially for removing gears, wheels, pulleys, cams, commutators and transmission parts from motors.

A drift and hammer have been used, ordinarily, in removing badly rusted parts, but this method had its dangers and resulted in trouble. The new device is fitted with adjustable arms and locking screws that afford a certain purchase. The pulling screw is of specially treated metal and fitted with a heavy screw point. It is possible to work on the smaller gears and transmissions by adjusting the diameter and using the smaller sized pullers furnished with the outfit.

Special attachments may be used with the puller as well as the adjustable arms. An arbor press attachment is supplied for it which automatically makes the puller available for arbor press work. For bending pipe, straightening shafting and removing universal joint yokes a special pipe bending attachment may be used. For removing solid web flywheels, gears and other similar parts, a stud fork attachment is made use of.



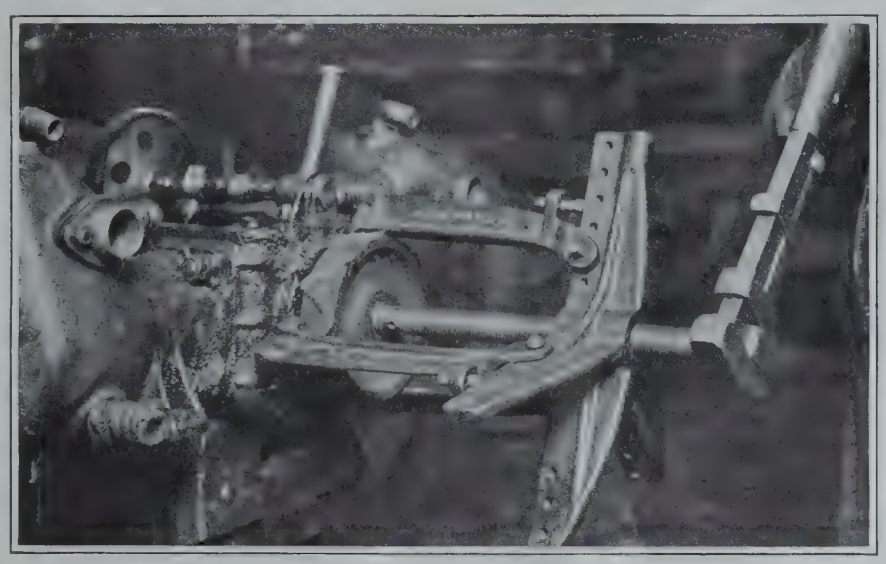

**Tire pressure-indicator which whistles when desired pressure is atttained**

## The Warning Whistle of Tire Over-Inflation

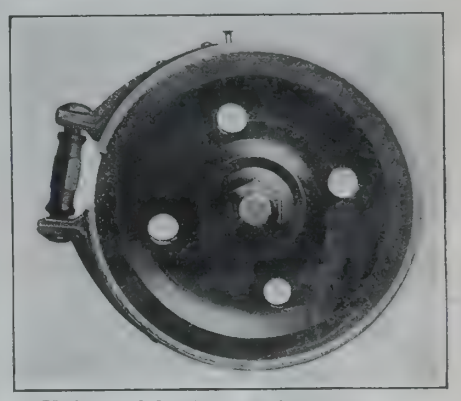
THE latest instance of ingenuity as applied to automobile accessories is the tire pressure-indicator shown in the accompanying drawing. This device consists of a casing connecting the pump connection with the tire valve and having a sounding chamber communicating with the main air passage by a small opening which is closed by a valve. This valve is held upon its seat by a graduated spring, mounted in the sounding chamber, and the cover of the sounding chamber has an opening covered by a harmonic vibrating reed.

In using this device it is first set to the required pressure by removing the cover of the sounding chamber and shifting the graduated spring around its center until the section adjusted for the pressure desired covers the valve and holds it to its seat. After replacing the cover, the indicator is screwed on the valve of the tire and the air supply hose attached. The pump is then started and kept going until the reed in the cover of the indicator sounds the warning that the proper pressure has been reached in the tire.

The action is simple. The spring having been set for a certain pressure, the valve connecting with the main passage will be held upon its seat by the spring as long as the pressure in the tire is less than the predetermined amount. But as soon as the desired pressure is exceeded, the pressure in the main passage will overcome the pressure of the spring, the valve will be lifted from its seat and air will pass into the sounding chamber and will set the reed into vibration, thereby giving the warning sound to the person at the pump.



**Removing a broken flywheel by means of a new device for automobile repairmen**



**Universal brake mandrel recently introduced**

## Simplifying the Relining of Automobile Brakes

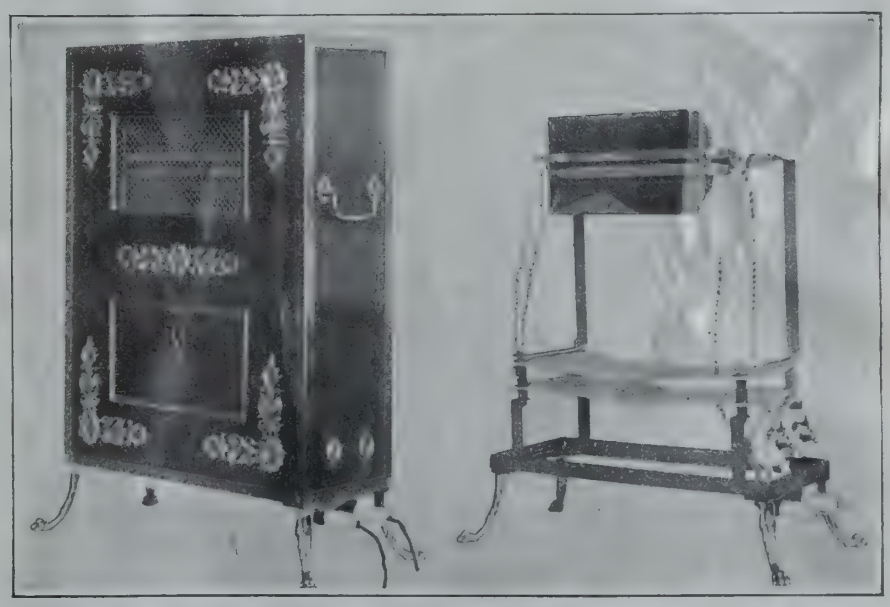
A DEVICE for relining brakes on all cars has been placed on the market by a Detroit manufacturer of automobile accessories. The brake lining and band are firmly clamped on a circular mandrel. The mandrel is turned until the rivet hole in the band comes to an upright position, then a split-rivet is driven in with a hammer blow and the rivet is clinched against the mandrel. This operation is repeated till all the rivets are in place.

Using this device prevents the lining from wrinkling or drawing the lining between the rivets. It is also possible to secure a perfect adjustment of the brakes at the time of replacement.

## Something New in Electric Stoves

FROM France comes a new departure in electric stoves, shown in the accompanying illustration. The heating element of this stove consists of a pair of special resistance rods, placed at the focal point of a copper reflector. Resistance elements are placed below the heating elements for the purpose of cutting down the usual lighting current to the proper degree. The entire mechanism fits into an attractive metal case, as shown.

The amount of heat delivered by this stove can be roughly controlled by turning on one or two of the heating rods, this being accomplished by means of the two toggle type switches shown at one side. The construction is exceptionally light.



**Two views of a new electric stove developed in France to help solve the fuel problem**

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

### Pertaining to Apparel

SHAWL MUFFLER.—L. GARWITT, 5 Pinehurst Ave., New York, N. Y. Among the objects of this invention is to provide a device for ladies which performs the function of a shawl, a muffler and a hood, and which is adapted to be used with the hood in operative position, or folded down on the muffler, and when in the last mentioned position the muffler will be provided with an ornamental collar. The device is especially adapted for use by motorists.

### Pertaining to Aeronautics

GUN CAMERA.—E. C. BASS, Avenue Edward, Biarritz, France. The object of the invention is to provide a camera especially designed for use on airplanes employed in training aviation schools to the art of aerial warfare with a view to record imaginary hits by photographs of the adversary. Another object is to permit the aviator to handle the camera similar to a gun and to permit of taking accurate aim.

### Electrical Devices

APPARATUS FOR MEASURING OHMIC RESISTANCE OF LIQUIDS AND SOLUTIONS.—T. H. REARDON, 44 W. Main St., North Adams, Mass. This invention relates to an apparatus for measuring ohmic resistance of liquids and solutions; it comprises a vessel of conductive material adapted to contain the liquid, a tube of non-conducting material having one end inserted in the said liquid, and adapted to be filled with the same, conducting material in contact with the liquid at the other and of the tube, an electric circuit connected at one end with the vessel and at its other end with the conducting material in contact with the liquid, and means for measuring the voltage or potential difference of the current in passing through the liquid or solution.

INCANDESCENT LAMP PROTECTING DEVICE.—H. F. WAY, Box 221, Oregon City, Oregon. More especially the invention has to do with what are known as weather-proof type of incandescent lamp sockets used in factories, and its object is to provide means whereby an incandescent lamp utilized with a socket of this type may be rendered inoperative for use with the ordinary type of socket, or with a weather-proof socket unequipped with the invention, the object being to prevent reuse of the lamp in another socket.

### Of Interest to Farmers

SEAT FOR AGRICULTURAL IMPLEMENTS.—J. C. BRIAN, 3938 5th St., N. E., Minneapolis, Minn. This invention has for its object to provide auxiliary mechanism for use in seats of agricultural implements for cushioning the seat, to eliminate shock and jar and to diminish to a minimum the disagreeable side motion, the auxiliary mechanism being designed to be arranged upon the usual pressed steel seat of the implement to provide a spring-supported seat.

AGRICULTURAL IMPLEMENT.—J. W. SCOTT, Falcon, Colo. The invention relates more particularly to clod breakers for use in connection with potato diggers and plows. An object is to provide a clod-breaking machine having a positive crushing, rolling and breaking mechanism, resiliently carried on the implement and being power-driven to effectually crush and pulverize earth being plowed up by the implement. A further object is to provide adjustable means for carrying the resilient tension.

### Of General Interest

STEPLADDER.—O. W. BROWN, JR., 12 Kemball St., Sanford, Me. An object of the invention is to provide a stepladder having rear or supporting legs which can be flared apart at their lower ends to give added support to the ladder and which will be securely held in this position. A further object is to provide a collapsible stepladder which is made of steel or other suitable metal which can be conveniently folded, and which can be secured in expanded form to securely and rigidly support the ladder in operative position.

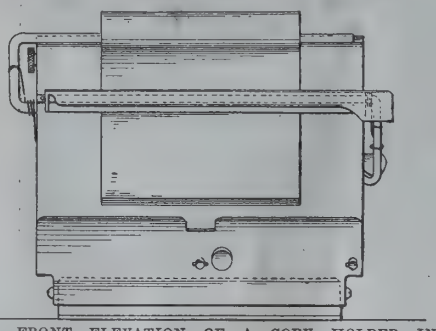
HYDRANT.—W. S. SNYDER, 321 50th Ave. N., Nashville, Tenn. The invention has for its object to provide a hydrant wherein the valve controlling the flow of water is normally spring-closed and is controled to opening position by the action of the hose connection. A further object is to provide a hydrant having drainage and wherein all the parts are protected from freezing, and may be easily removed for repair.

SPONGE RUBBER ARTICLE AND METHOD OF MAKING THE SAME.—J. B. WISHART, 20 N. Westfield St., Trenton, N. J. An object of the invention is to provide a sponge rubber ball or other article of great resiliency. A further object is to provide a method of making sponge rubber articles which results in an article having in its central portion relatively large cells, the cells decreasing in size toward the exterior of the article, and at the exterior the cells being minute so that the surface is practically a smooth continuous one permitting of necessary wear.

PRESSURE BAR MECHANISM.—W. E. MOORE, Janesville, Wis. The invention relates to filling fountain pens having a compressible bag. The object is to provide locking means adapted to engage an interior shoulder in the barrel to normally lock the pressure bar mechanism in position on the barrel but allow free functioning of the same whenever it is desired to fill the fountain pen, and to permit the user to conveniently unlock the mechanism whenever desired.

PRICE MARKING SYSTEM.—H. and L. HOPP, Hopp Press, Inc., 230 W. 17th St., New York, N. Y. This invention relates to numbered cards used for designating prices of articles offered for sale. An object is to provide a simplified price marker system comprising a number of cards with cent marks which are simple and convenient to handle and which may be made up into any price denomination from 1 cent to 99 cents. A further object is to provide a system which embodies very few cards as compared with the usual system.

COPY HOLDER.—A. N. WOODRUFF, 459 Hudson St., New York, N. Y. The invention relates more particularly to copy holders of the movable marker type. An object is to provide a copy holder in which a step-by-step



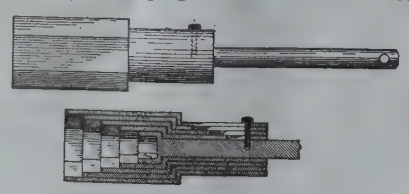
A FRONT ELEVATION OF A COPY HOLDER IN ACCORDANCE WITH THE INVENTION

movement of the marker is obtained by a simple construction, and, at the same time a mechanism of this character which is positive in operation and adaptable to copies having different spaces between the lines, is also provided.

### Hardware and Tools

GRINDING TOOL.—P. U. LOVELACE, Clinton, Okla. An object of the invention is to provide a tool which can be manually operated to regrind or true up crank pins or journals on automobiles, engines and the like after they become flat or out of the round. A further object is to provide a tool which can be manufactured at a reasonable price, and conveniently used without the necessity of employing skilled labor.

WRENCH.—S. C. ROSENBERG, First Natl. Bank Bldg., 42 Church St., New Haven, Conn. An object of the invention is to provide a combination socket wrench having a series of telescoping nested socket members



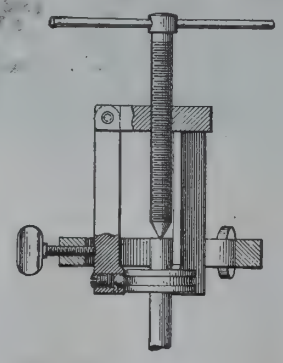
A VIEW IN LONGITUDINAL SECTION

adapted to be quickly adjustable and secured in various longitudinal positions relative to each other so as to present any of the sockets for operation in accordance with the size of the nut or bolt head.

### Machines and Mechanical Devices

NEWSPAPER VENDING MACHINE.—O. J. HOTALING, 420 Ogden St., Newark, N. J. Among the objects of this invention is to provide means for ejecting the newspapers singly. Another object is to provide means for preventing the introduction of a coin or check in the machine when it is empty of newspapers. The invention relates particularly to a device of this character covered by U. S. patent No. 1,285,187 issued Nov. 19, 1918.

BEARING PULLER.—F. J. HEINRICH, 204 N. Yakima Ave., Yakima, Wash. The invention especially relates to a device for pulling magneto and small generator bearings. The



A SECTIONAL PLAN VIEW OF THE PULLER

general object is to provide means for engaging the bearing whereby to securely grip the bearing and to be maintained in position against the tendency to slip and disegage under the pressure exerted endwise against the shaft. Also the engaging member is readily renewable if broken.

SPEED OPERATED CIRCUIT CLOSER.—F. E. TOUCHY, 2518 Ave. I, Galveston, Texas. The invention is more particularly intended for use in connection with an alarm on elevators for grain and other foodstuffs in which the belt not infrequently slips or the elevator chokes owing to too much feed, loose buckets, or an obstruction in the head or boot of the elevator, causing loss of time and sometimes producing fires; when such conditions exist a governor will act through the circuit closer to cause an alarm to be sounded.

### Musical Devices

CUSHION SUPPORT.—F. W. BOCKING, Rifle, Colo. This invention relates to cushion supports in the form of a resilient pad adapted to receive the feet or casters of any form of musical instrument such as victrolas or pianos and which will absorb the sound vibrations ordinarily transmitted by the instrument to the floor, thus improving the tone and eliminating harsh unpleasant tones caused by contact of the instrument with the floor.

### Prime Movers and Their Accessories

VAPORIZER.—M. K. THAYER, Apostol, Wyo. The invention relates generally to internal combustion motors and more particularly to heating means therefor, whose function is to warm up and limber the motor when cold. The object is to provide a simple apparatus of this nature, which will not interfere in any way with the normal operation of the motor and which will be readily accessible and easily perform its intended functions previous to starting.

INTERNAL COMBUSTION ENGINE.—C. C. MANKER, Mayfair Apts., 40 St. James St., Los Angeles, Cal. An object of the invention is to provide a multi-cylinder engine of a relatively light weight, i.e., light in weight compared wth the amount of power generated. A further object is to provide an engine having a "wabbler" with opposite pistons on each side thereof, said opposite pistons being connected by straight piston rods which are operatively connected with the wabbler thus obviating the tendency to side thrusts.

AUTOMATIC GAS CONTROLLER.—E. T. OFELDT, Spring Lake, N. J. This invention relates more particularly to automatic means for controlling the feed of gasolene and air to an internal combustion engine in accordance with the speed of the engine. A further object is to provide means which can be attached to any gasolene engine and which operate as an adjunct to manually control the means so that the desired proportion of gasolene and air can be regulated for starting and then automatically regulated after the engine is warmed up.

### Railways and Their Accessories

CAR DOOR.—R. A. EDGAR, Carlyle, Kan. The invention relates to doors for railroad cars and has for its object to provide a door of the characters specified especially designed for cars used in hauling local merchandise, or for cars where it is desired to inspect the contents at any time and which may be applied to existing doors without change of the car.

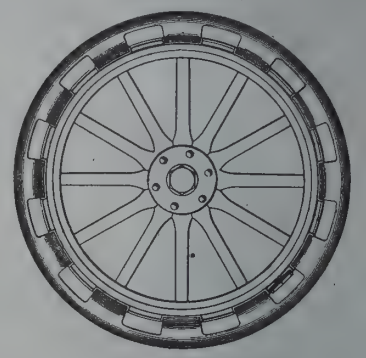
### Pertaining to Recreation

TOY BOOK.—M. GOODMAN, 545 W. 164th St., New York, N. Y. Among the objects of the invention is to provide a book or a device having many characteristics of a book, including covers and movable inside members such as leaves having peculiarly arranged legends, figures, cuts and descriptive matter, means being provided in connection with the book to make the inscriptions carried by the leaves legible not only directly but also indirectly by reflection in a mirror, an object being to provide amusement and to familiarize a child with the principals of reflection.

### Pertaining to Vehicles

HEADLIGHT DIMMER.—P. P. HEIN, 444 E. 79th St., c/o Bory, New York, N. Y. The invention has particular reference to means to nullify the objectional glare commonly accompanying a powerful light. An object is to provide an attachment for a standard lamp, which may be readily applied, sufficiently far in front of the lamp to provide for an appreciable amount of laterally and rearwardly projecting light for illuminating the roadway at the sides of the vehicle and enabling persons at a distance to recognize the nature of the vehicle, yet sufficient light to meet all requirements being projected ahead.

CUSHION TIRE.—I. N. KEIM, 101 Garden St., Mount Holly, N. J. More particularly the invention has for its object to provide a cushion tire designed to be used in lieu of the pneumatic or inner tube inflated tires,



A FACE VIEW OF WHEEL PROVIDED WITH INVENTION

yet arranged to give the desired resiliency, and to withstand heavy service especially when used on truck wheels. Another object is to securely hold the cushion tire against accidental radial displacement.

### Designs

DESIGN FOR A CALENDAR MOUNTING.—A. J. MCDADE, c/o Natl. Calendar Co., 416 N. Y. World Bldg., New York, N. Y.

DESIGN FOR A SPOOL HOLDER.—P. O. MUELLER, 628 Decatur St., Brooklyn, N. Y.

DESIGN FOR A DOLL.—S. P. STARKWEATHER, 2426 Bowditch St., Berkley, Cal. The inventor has been granted two patents of a similar nature.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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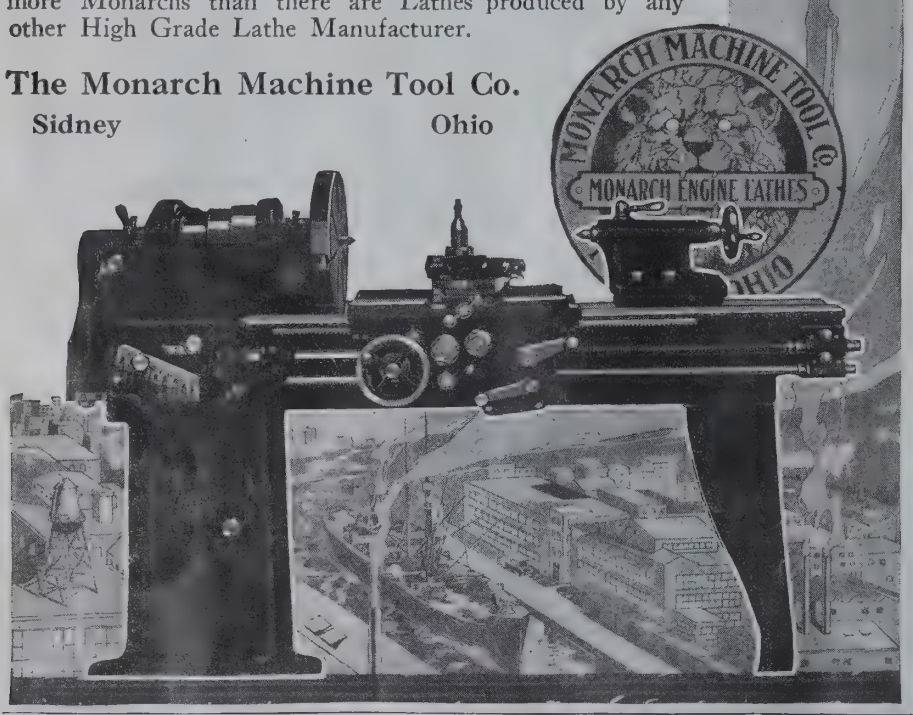


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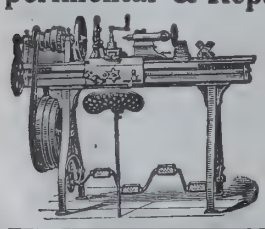

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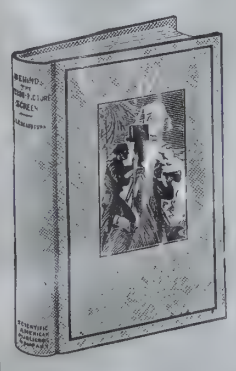

## *Behind the Motion-Picture Screen*

THE mysteries of the "Movies" are bared at last It has remained for Austin C. Lescarboura of the Editorial Staff of the Scientific American to undertake the task of answering the thousand-and-one questions constantly being asked by screen "fans" and aspirants to screen careers, in his book entitled, "Behind the Motion-Picture Sreen." Among the subjects covered in his work are:

Scenarios. The Director and His Work. Motion-Picture Acting. Motion Picture Cameras and How They Work. The Cameraman. In the Land of Make Believe. Studios. Mob Stuff. Tricks of the Screen. Laboratory Work. Pictures in Natural Colors. Microscopic Subjects. Talking Pictures. Animated Cartoons and Sculpture. Motion Pictures in Odd Fields. Motion Pictures in the Home and Business. Present Status and the Future of Motion Pictures.

This book has been written in a simple, interesting, and instructive style. It is not technical; yet it covers all phases of the screen art in an accurate and unbiased manner. Pictures? Certainly; this book is the best illustrated book on the subject—over 300 pictures. Indeed, every right-hand page is a picture page; every left hand a corresponding text page. It is something entirely new in book making. "Behind the Motion-Picture Screen" contains 426 pages and over 300 illustrations, printed on the finest coated paper and bound in an attractive cloth cover measuring 6¼ by 9¼ inches. **Price, $3.50 net; Postage Extra.**

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## More Starting Power for the Steam Locomotive

(*Continued from page 295*)

the reverse lever in the corner, and when the locomotive cylinders are getting steam. After steam is admitted to the cylinders the crank-shaft pinion transmits its power through an idler gear to the trailing axle. Hooking up the reverse lever two notches or more automatically disengages the booster and brings it to rest.

The booster puts any locomotive with trailing wheels into the next class above in starting effort, because the trailing wheels act as an additional pair of drivers. On freight trains this means more tons per train because of greater starting effort, and avoids damage to equipment because of a smooth steady start. On passenger trains it means smooth starting and quick acceleration to road speed. This adds to the comfort of the traveling public, protects the equipment from damage, and renders schedules more easily maintained by avoiding delays in starting.

## The Disaster to One of Our Latest Submarines

(*Continued from page 298*)

fifteen to twenty feet of the stern of the craft above water. She was brought up to this position by blowing the water from the after trimming and ballast tanks.

The crew now made heroic efforts to cut through the shell of the vessel, which is here about three-eighths of an inch in thickness. Breast drills and ratchet drills were used, aided by cold chisels, hacksaws and a heavy electric drill. Thoroughly soaked to the skin, rendered dizzy by gas fumes, and without any food, the men, in the words of Commander Cooke, "fought like heroes for their freedom and lives." He tells us that when the current was turned on the electric drill, a large part of the power passed through the body of the man operating it, "knotting his muscles, binding his arms to his side and subjecting him to excruciating agony." Finally, by Thursday morning, the crew had cut a small hole, and managed to make the signals already referred to. By wig-wagging this signal they attracted the attention of the "Alanthus," which gave an alarm and, finally, through the efforts of the crews of this vessel and the American liner, "General George Goethals," food, water and fresh air were passed to the crew and a sufficiently large hole was cut to release them.

The disaster was due to the failure to close the outboard air valve from the control room. In future this valve will be closed *before* the order is given to dive. The valve being open, as soon as the vessel submerged the water found its way in through the induction valves in the various compartments. Fortunately the motor room valve was tightly closed, but the valve in the engine room was not fully closed down and leakage occurred here. The valve in the torpedo room was open, or only partially closed, and the quick flooding of that compartment occurred. The inquiry which will be held will determine definitely whether there was panic in the torpedo room and a failure to realize that the valve had not been driven home, and whether a proper effort was made to close it before the men escaped through the bulkhead.

## Timing the Hundred-Mile-Per-Hour Racer

(*Continued from page 299*)

minutes, three and eight one-hundredths seconds, for an average speed of 99.65 miles per hour. At the start of the qualifying trial he crossed the wire at a time recorded by the clock as 6 hours, 50 minutes, 18 seconds, and 23-hundredths seconds. When he completed the first lap the timing instrument registered 6 hours, 51 minutes, 50 seconds and 6-hundredths seconds. Subtraction of the first time from the second gave 1 minute, 31 and 83-hundredths seconds—the exact time of the lap. This operation was repeated for each lap, the fastest lap being negotiated in 1 minute, 30 and 8-hundredths seconds.

The tape, shown in one of the accompanying photographs, on which DePalma's four record breaking laps are recorded, shows the following figures:

| | Hours | Minutes | Seconds | Hundredths |
|---|---|---|---|---|
| End fourth lap. | 6 | 56 | 21 | 31 |
| End third lap.. | 6 | 54 | 51 | 23 |
| End second lap. | 6 | 53 | 20 | 73 |
| End first lap... | 6 | 51 | 50 | 06 |
| Start first lap... | 6 | 50 | 18 | 23 |

Total time, 4 laps, 6 minutes, 3 and 8 one-hundredths seconds.

Lap time—First lap, 1:31:83. Second lap — 1:30:67. Third lap — 1:30:50. Fourth lap—1:30:08.

## The Toolmaker's Tools

(*Continued from page 302*)

the molten ferro-silicon remains at the bottom. When the furnace is full it is pulled out of the way, the alumina allowed to solidify and the sides taken off. The pig as it is called is then removed and allowed to cool. Several of the companies tap the molten corundum and operate each furnace continuously although the majority use the intermittent type.

The pig, now fused and crystalline corundum, is broken up and sent to the finishing plant where the material is crushed, refined and made ready for wheel manufacture. Much depends upon the skill with which the furnace is operated. The size of the crystals, their freedom from impurities, etc., all play an important part in the quality of the finished product. Carborundum is another product of the electric furnace and is of interest in that it is never found in nature but is purely an artificial product. Its commercial production is due to E. G. Acheson, who in 1891 made the crystalline carbide of silicon in carrying out some experiments on the crystallization of carbon.

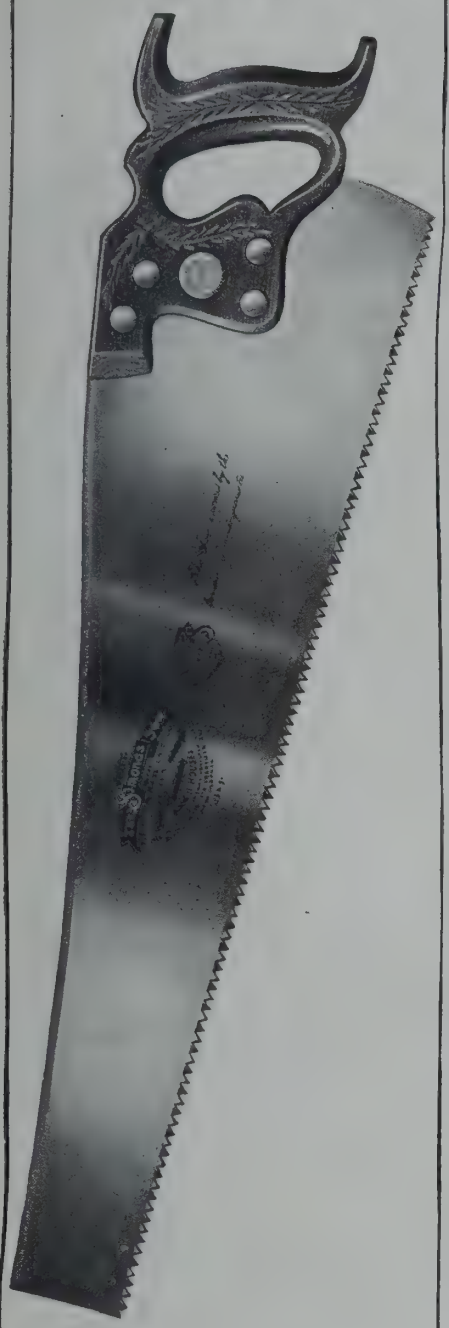
The raw materials used in the making of carborundum are quartz or silica, coke, sawdust and salt. The sawdust is added to make the charge porous and to permit the escape of the carbon monoxide formed during the reaction. The raw materials are heaped up around a central core of carbon or graphite and the heat generated in the furnace by the passage of electric current effects the conversion of the carbon and silica of the charge into carborundum or silicon carbide. The salt is added to remove the impurities in the coke and sand, such as iron, by the formation of volatile chlorides.

On dismantling a carborundum furnace after the completion of a run a great variety of products is found. The carbon core is completely converted into graphite and is surrounded by a ring of crystallized carborundum. Next to this is a layer of carborundum powder while outside this again is a ring of siloxicon or fire-sand which is a compound of silicon, carbon and oxygen. This latter is used largely as a refractory substance.

From the above it is seen that the temperature plays an important part in this reaction and it has been found that the range within which the carborundum is formed is from 1,550 to 2,200 degrees Centigrade.

Artificial corundum and carborundum, both of which are sold under a multitude of trade names, form the basis of the modern abrasive industry and are applied to uses best adapted to their characteristics. Aluminous abrasives find their greatest use in the grinding of substances like steel in their characteristics, while carborundum is used to a greater extent on cast iron and in the masonry trades.

SIMONDS
SAWS



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Both make valuable refractory substances and, in passing, carborundum brick is now being successfully used as a lining for boiler furnaces. Carborundum is also used in the elimination of gases from steel since it acts as a powerful de-oxidizer.

In the making of the actual wheel a variety of bonding materials, which serve to hold the abrasive grains together, are used. The greater portion of the wheels is made by the vitrified process. Suitable clays and fluxes are mixed in the proper proportions with the grains of abrasive. After the mixture is just right it is poured into molds and worked up and down to eliminate air bubbles. The molds rest on some absorbent material and the rough wheel soon dries partially out. It is then rough shaved and the central hole bored and is then placed in ovens where all the moisture is driven off.

The wheel is then ready for the kiln and the burning process which follows resembles that in use for porcelain ware. Saggars are used to contain the wheels. The saggars are rings of fireclay covered top and bottom with fireclay tile. Quartz sand is used inside these saggars to prevent the flame from reaching the wheels while being vitrified.

The kiln is started with a slow fire and is 72 hours attaining the maximum temperature of 2,300 degrees Fahrenheit. The kiln is then allowed to cool down gradually for a period of five days, when the charge is drawn.

The burning process is a delicate one and requires much skill. If the temperature is changed too suddenly, the wheels will crack and if they receive too much heat they will be too hard, while if too little, too soft. After being fired the wheels are trued up and are ready for market.

For silicate wheels the same abrasives are employed as for the vitrified process; a different bond is used however. Silicate of soda or waterglass is the principal bonding material used in the manufacture of these wheels. After it has been thoroughly incorporated with the abrasive in mixing machines, the whole mass has a thick adhesive nature. It is then tamped into molds, a cover put on and the whole baked in an oven at about 800 degrees Fahrenheit.

Shellac is the principal ingredient in the bond of elastic wheels. After the mixture has been prepared its consistency is such that if for thin wheels it may be rolled into shallow molds. Thicker wheels are molded under hydraulic pressure or rammed into molds the same as silicate wheels. They are then baked at a low temperature to set the shellac. By the elastic process very thin wheels may be made and used with safety. Wheels as thin as 1/32 inch are procurable and find considerable use in the cutting of high speed steel. Wire mesh is sometimes inserted in them for strength.

## Solving the Labor Problem—I

(*Continued from page 304*)

courtesy to and consideration for the other fellow.

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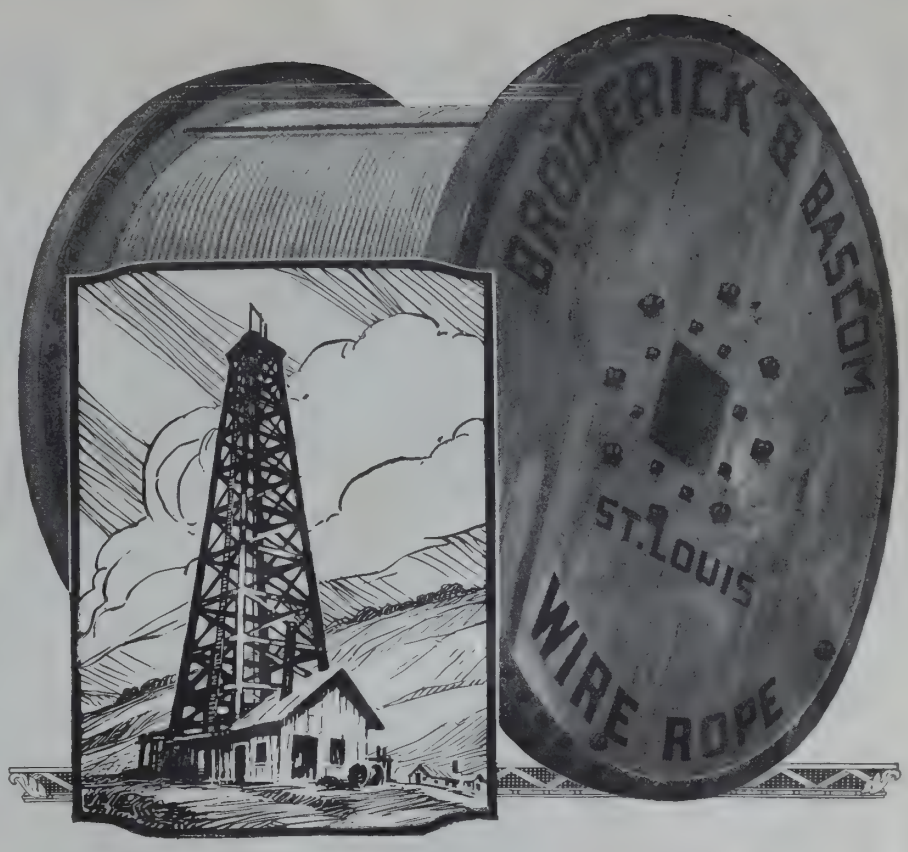


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## Reconstructing Stonehenge

(*Continued from page 308*)

put in hand. Steel joists are attached to the protecting framework, four screw jacks are placed beneath them, and gently, just a fraction of an inch at a time, the stone is lowered back into its original hole. Having obtained from the earth all the evidence of origin that can possibly be found, the base is filled in with concrete thus giving the pillar a solid and sure foundation.

While this giant surgery that is being practised on the trilithons is an interesting thing to see there is something else happening at Stonehenge less spectacular, but to the archaeologists, still more exciting. One by one at an interval of about seven paces from one another a whole ring of newly discovered holes has been laid bare just inside the earthwork which surrounds Stonehenge. An old map gave the clue to their existence. It showed certain—now vanished—depressions in the turf and the excavators determined to ascertain what they meant. Equipped with a heavy steel bar with a sharp point they began their search. Once they found the first hole the others soon followed; the steel bar, instead of encountering the hard chalk, went right through; the turf was turned back and there with all the fascinating accuracy of a puzzle, was the hole just where it ought to be.

It is believed that these holes held stones—not of the size of the huge trilithons; but yet of a good size—and if that be so, then outside the two circles of Stonehenge and the two horse-shoes there was yet another ring, and this was, perhaps, there before Stonehenge as it is known today was built. There are no stones in any of these holes now. It may be that the now prone "Slaughter Stone" which lies outside Stonehenge proper once belonged to this newly found circle.

It appears that at some period these holes were used as burial or cremation places, for there have been found in each of them a quantity of burnt human bones. Many years ago bones of animals were dug up round the Altar Stone, and among the ruins numerous stone implements have been found. Of metals nothing has been unearthed except a small piece of copper.

The discovery of these stone implements and the entire absence of iron and other metals have led many scholars to conclude that Stonehenge was reared when early man in Briton still used tools of stone and when metals were barely known. That takes us back to sixteen or eighteen centuries before the birth of Christ, making Stonehenge somewhere between 3,500 and 4,000 years of age.

At present there is certainly no definite evidence as to its age or for what purpose the early Briton reared this wonderful pile. Some have ascribed it to the Druids, but when they appeared in Briton not only copper, but bronze and iron were known and used. Others have said it was a Buddhist Temple, and still others that it was a fortress, or a meaningless pile which the Romans compelled the Britons to build in order to keep them quiet.

Its origin is wrapped in mystery. We know the date of nearly all the world's great ruins, but not of Stonehenge. It is equally true to say that we have no definite knowledge either as to the use to which it was put. It was hardly reared as a monument to some mighty chief, for no honored dead was ever laid to rest beside the Altar Stone.

But the discovery of animal bones in large numbers round the Altar Stone and the unearthing of burnt human bones by the present restorers inside the earthwork would go to show that it was a temple or worshipping place of the early Britons.


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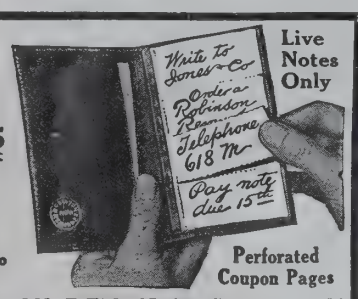


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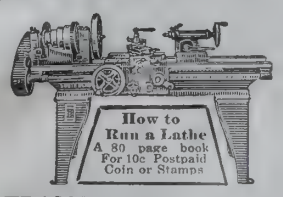


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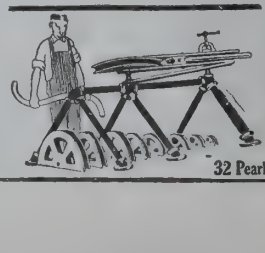

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Mr. Eugene Higgins offers through the SCIENTIFIC AMERICAN a prize of $5,000 for the best essay on the Einstein theories so written that it may be read with profit by an ordinarily intelligent person with no special mathematical training. The competition is open to any person, without restrictions of any sort, subject to the following

**CONDITIONS:**

1. No essays shall be longer than 3,000 words.

2. All essays must be in English, and written as simply, lucidly and non-technically as possible.

3. Each essay must be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted.

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The Committee of Judges will consist of Professors Leigh Page of Yale and E. P. Adams of Princeton. In the event that they are unable to agree on the best essay, the Einstein Prize Editor will cast the deciding vote.

These bones were the victims of the sacrifices. With these some primeval priest conciliated his deity. But what god it was that the early Britons worshipped amid these circles of massive stones we cannot at present say.

Now that Stonehenge has become the property of the nation and is being restored under the guidance of expert engineers and archaeologists, it is certainly to be hoped that they will be able to throw some light on these much-discussed problems. Already they have been on the ground for six months, but so colossal is the task that another year and perhaps two will expire before their work is finally finished. By that time the riddle of Stonehenge may be solved. Who can tell?

### To Make Hens' Eggs Hard

WE do not refer to the familiar boiling process, but to a method of making the shells thick and tough. This is a trick of the trade known by veteran poultrymen. Make up a supply of lime-water, just as though you were preparing whitewash, and strain off the liquid. Use this for several days in the poultry wet mash, at the rate of about a quart of liquid to 100 hens.

"There is nothing I know," declared a poultryman of many years' experience, "which will stop soft-shelled eggs in a flock so quickly and sensationally as this. Lime, of course, is the principal element in the egg shell, and the limewater supplies it in concentrated form. The eggs will become so hard that you can pour them from a basket just the way you pour water from a pail, and they won't break."

This is a poultry trick you can try on your friends. You can make your flock renowned all over the district for its hard-shelled eggs, and nobody will guess the simple secret.

But ordinarily, soft-shelled eggs in a flock can be corrected by other methods. Always, of course, there ought to be ample oyster shell before the flock. Then the feeding of alfalfa or clover is a great help, as these materials contain considerable lime.

It is possible, of course, to have eggs with shells too hard. At the hatching period, shells of only medium thickness are desired, as they can be broken by the chick without undue labor. The danger at other periods is more from soft-shelled eggs—not so much because they must be handled more carefully, which is the case, but because they break easily in the nest and may cause the flock to acquire the egg-eating habit, an exasperating, disagreeable thing to fight.

### "Flu" Experiments on Monkeys

DEVOTEES of the theory that man is a remote descendant of the ape family will seize with avidity upon the scientific conclusions of medical authorities that monkeys, like folks, are susceptible to the attacks of influenza. Under the direction of Major F. G. Blake and Major R. L. Cecil, the Army Medical School of Washington, D. C., recently completed tests with 22 monkeys to determine the effects of influenza on the ape family.

The monkeys were inoculated with B. influenzae by swabbing the upper respiratory tract with a culture of the disease germ isolated from a case of influenzal pneumonia which had developed in a man. The virulence of the disease was subsequently raised. The period of incubation embraced from three to six hours.

The experiments indicated that influenza exercised the same influence on monkeys as on the human family with respect to its behavior, symptoms, complications and pathology. The medical directors described the action as "an acute self-limited respiratory disease identical with influenza in man." Similar results were obtained when pursuing a different method of inoculation, intra-tracheally, with the exception that one monkey evidenced no signs of infection.


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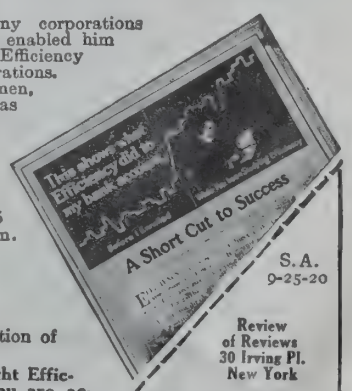


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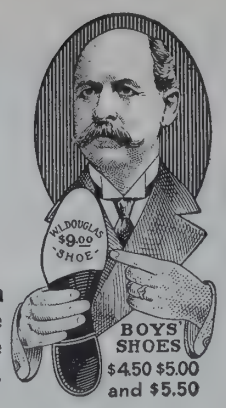


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## NEW BOOKS, ETC.

ELECTRICIAN'S HANDY BOOK. By T. O'Conor Sloane, A.M., E.M., Ph.D. New York: The Norman W. Henley Publishing Company, 1920. 12mo.; 823 pp.; 600 engravings.

As a practical survey of the whole electrical field, proceeding gradually from elementary to advanced topics yet keeping all within the compass of an easy handful of book, this improved edition combines the features of a small encyclopedia, a text for the student, and a reference work for the advanced electrician. By ignoring obsolete machinery and methods it makes room for a surprising amount of modern theory and practice.

THE ENGINES OF THE HUMAN BODY. By Arthur Keith, M.D., LL.D., F.R.S. Philadelphia: J. B. Lippincott Company, 1920. 8vo.; 284 pp.; 2 plates, 47 figures.

The general reader will gain a fresh and arresting conception of the body from this simple account, which regards the muscles as reciprocal engines, the bones as levers, the cartilage and synovia as elements of a perfect lubricating system, the heart as a double pump, and the thorax as bellows. We are shown heat-regulating devices, transport and postal systems, workshops and laboratories; in connection with the brain, the master machine, we find cameras, telephones and a stabilizer. Thus the body is viewed from the standpoint of the mechanical engineer, and concrete, vivid impressions result in indelible memories.

PROPORTIONAL FORM. By Samuel Colman, N.A., and C. Arthur Coan, LL.B. New York and London: G. P. Putnam's Sons, 1920. 8vo.; 265 pp.; 156 illustrations.

Those who had the pleasure of seeing "Nature's Harmonic Unity" will enjoy this supplemental volume by the same authors. In it they demonstrate that order, as heaven's first law, is as conspicuously the rule in beauty as in the heavenly bodies. Why do certain forms delight us, while others repel? The work goes far toward answering this natural question by pointing out the laws of a harmony of form analogous to those of motion, music, and color, in which able aid is contributed by Mr. Colman's rich gallery of drawings, geometrical, botanical, architectural, and physiological. The architect and designer will find here basic research and suggestion, but the facts are phrased for "all students of beauty past and present."

NEW GEOGRAPHY, BOOK TWO. By Wallace W. Atwood, B.S., Ph.D. New York: Ginn and Company. 4to.; 304 pp.; maps and illustrations.

The second book of the Frye-Atwood two-book course in geography adopts, for the first time in an American text, the regional treatment used by the best European schools. This divides the world into regions according to life-conditions, and organizes work around the problem method, in which the class studies with the book open before it and is led by judicious questioning to make educative generalizations. The text stresses city geography—in which section nine airplane drawings are a feature—and correlates geography with history. The book's graphic and dramatic qualities engage the undistracted attention of the grammar-school pupil.

APPLIED AERODYNAMICS. By Leonard Bairstow, F.R.S., C.B.E. New York: Longmans, Green and Company, 1920. 8vo.; 565 pp.; illustrated.

"Applied Aerodynamics" is a work of substance and distinction. As adviser to the British Air Ministry the author had access to authoritative sources, and findings from the unpublished reports of the Advisory Committee, covering the period of the war, are generously besprinkled throughout the work. The new knowledge is utilized in a careful exposition of the principles of flight and their practical application. The book includes a description of the different classes of aircraft and develops the laws of stable flight on elementary principles. Then come details of today's practice, with analyses of performance. Experimental modes of obtaining basic facts from actual flight and from models and parts in wind channels are thoroughly canvassed. The photographic studies of flows and eddies are worthy of special mention.

ZOÖLOGY. By T. D. A. Cockerell. Yonkers-on-Hudson, New York: World Book Company, 1920. 8vo.; 580 pp.; illustrated.

A new volume of the "New-World Science Series" is this text-book for colleges and universities by a professor of zoölogy in the University of Colorado. Prof. Cockerell strives to present his information in such manner that a residue of vital importance will be left in the student mind. Details of structure and classification are not carried to a bewildering complexity, and numerous biographical chapters introduce the element of human interest. The New York Zoölogical Gardens contribute many of the excellent photographs, and the drawings were made expressly for this work. Among other subjects handled with a sure touch are the origin and migrations of fauna, genetics, and entomology.

CUBA, PAST AND PRESENT. By A. Hyatt Verrill. New York: Dodd, Mead and Company, 1920. 8vo.; 240 pp.; illustrated.

An inviting volume is this, with enough pre-intervention history to justify its title; for the rest, we find broad sketches of Cuba's physical, climatic and industrial features, intimate glimpses of Havana and Santiago, life and customs, and notes on travel. There is a good folding map, and the new edition incorporates 1919 facts and figures.

TELEPHONIC TRANSMISSION. By J. G. Hill. New York: Longmans, Green and Company, 1920. 8vo.; 400 pp.; 196 diagrams.

Designed as a bridge between mathematical theory and its application to the problems of the telephone engineer, this British work helps him to efficient and economical solutions. The reader will find a great many fully-worked-out examples involving the use of transmission formulæ, and a chapter on transmission measurements; simple proofs of transmission equations are furnished, in addition to the usual proofs requiring a high degree of mathematical knowledge. Practical applications of laws are given generous space, and important cost problems and standard cable practice are carefully set forth.

PROSPECTOR'S FIELD-BOOK AND GUIDE. By H. S. Osborn. Revised by M. W. von Bernewitz. New York: Henry Carey Baird and Company, 1920. 12mo.; 400 pp.; 57 illustrations.

Osborn's original work was of great assistance to prospectors; in the present edition a technologist of acknowledged ability has embodied the new knowledge of the past five years; the need of technical training is emphasized, and the student is taught how to search and how to test. Precious and base metals, and the non-metallic minerals, are given separate chapters; the value of the blowpipe is demonstrated; and oil is dealt with at great length.

CHIMICA ORGANICA. Part I. By Dott. Ettore Molinari. Milan, Italy: Ulrico Hoepli, 1920. 8vo.; 624 pp.; 254 illustrations.

This valuable and substantial work appears in a third edition, revised and amplified. Statistical data accumulated since 1913 are added to the original contents. The first section of the volume deals with analyses, determinations and properties in a general way, and concludes with the classification of organic substances and the official nomenclature. The second section deals specifically with the applications and processes involved in the industrial utilization of important substances such as petroleum, alcohol, acids and their derivatives.

GEOLOGY OF THE MID CONTINENT OIL-FIELDS. By T. O. Bosworth, D.Sc., M.A., F.R.G.S. New York: The Macmillan Company, 1920. 8vo.; 314 pp.; illustrated; folding map.

Kansas, Oklahoma and North Texas embrace the world's greatest developed oil region, and give the world one-third of its production. Dr. Bosworth has drawn freely upon our Government and State bulletins and other available sources of knowledge; he gives the history of the region's development, detailed statistics of production, the general geological structure of the territory, and localized structures, presenting tables and analyses and providing much information as to processes. It is a compendium that, from the geologist's point of view, is of decided value.

THE WESTINGHOUSE E-T AIR BRAKE INSTRUCTION POCKET BOOK. By W. W. Wood. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 258 pp.; illustrated.

Patient, capable instruction marks this revised edition of a well-known pocket book, and the man who demands full knowledge in contradistinction to a limited grasp of material details will find satisfaction in the work. Particularly noticeable are the self-explanatory illustrations, in which each zone of air pressure is given its own distinguishing color. Examination questions and answers cover the No. 5 and No. 6 equipment, their operation, and approved procedure in case of breaks.

SEVENTY-FIFTH ANNIVERSARY NUMBER

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

THE MATERIALIZED DREAM OF SEVENTY-FIVE YEARS OF PROGRESS

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# OWNERS' FAITH
## *in*
# WHITE TRUCKS

THE following list of large investments in White fleets shows the faith large truck owners have in White equipment.

| | | | |
|---|---|---|---|
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| **4 owners have invested between** | **1,000,000** | **and** | **$2,000,000** |
| **5 owners have invested between** | **500,000** | **and** | **1,000,000** |
| **22 owners have invested between** | **250,000** | **and** | **500,000** |
| **82 owners have invested between** | **100,000** | **and** | **250,000** |

Experienced truck users *know* truck value in terms of earning power, through actual performance of one truck against another.

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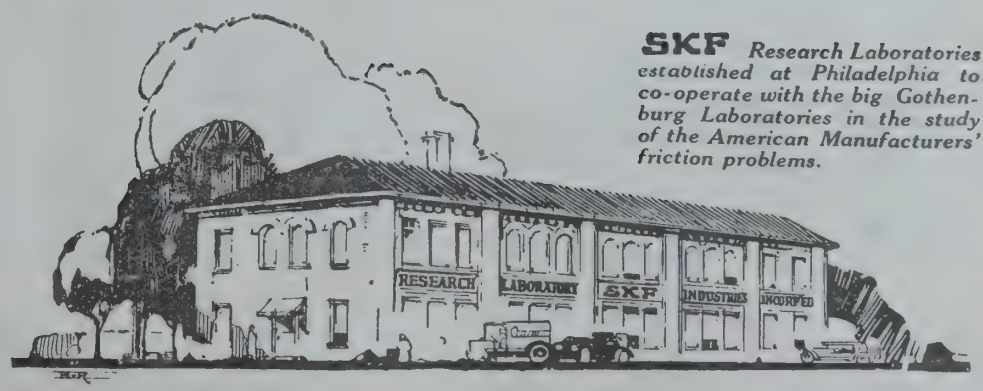


**SKF** *Research Laboratories established at Philadelphia to co-operate with the big Gothenburg Laboratories in the study of the American Manufacturers' friction problems.*

617

THE SCIENTIFIC AMERICAN, October 2, 1920. Volume 123, Number 14. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price $6.00 per year
Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

# Announcing Packard "Single Six"

## *The 10-Year Car*

WE have always made large cars designed for maximum speed, great power, and all the roominess that goes with a long wheelbase. The ultimate development has been the Twin Six, which has firmly established itself in the regard of the public, and which we have been producing and marketing for a number of years.

Packard reputation for motor cars rests solidly upon the *Twin Six,* and it always will!

Packard

But there has for years been an insistent demand for another car to supplement the Twin Six: a car of shorter wheelbase and lighter weight, a general-purpose car of great maneuverability in traffic, one that would park in a short space at the curb.

And the demand was that this light car should give unusual gasoline mileage and tire mileage, and finally, that it should be designed and built Packard-wise, and therefore be able to keep out of the repair shop longest and to require least attention from its owner or driver.

We thought it over and studied the problem for a good many years, during all of which we were accumulating experience in the design and production of the highest possible grade of car.

We have at various times during the past ten years designed a light-weight companion to our larger cars, but were never entirely satisfied with our efforts.

Then the war broke out in 1914, and believing that America would inevitably become involved, we turned our attention to designing airplane engines, and from then to the close of the war had a thoroughly successful experience in designing and manufacturing airplane motors, which, as you know, must give the greatest power with the least possible weight.

* * *

We learned a great deal through this experience that was applicable to the automobile, and towards the close of the war we felt we were finally well equipped by experience to design the light-weight car.

Meanwhile, with a constantly growing talk of congestion in traffic, and increasing cost of gasoline, tires and other supplies, the demand for the light car became more and more insistent.

* * *

We have taken several years for the development and perfection of this new Packard, but we believe we have accomplished what we set out to do, and take now a pride in announcing that the Packard Single Six will soon be ready. It will be manufactured alongside the Twin Six and by the same matured and experienced organization.

The new car is of five-passenger capacity and will be offered in Touring, Runabout, Coupé and Brougham or Sedan.

The motor has six cylinders, 3⅜" bore by 4½" stroke. It is therefore of medium size, and despite its light weight is very sturdily built.

It is equipped with the Fuelizer.

The *Single Six* motor is new throughout, but it is not experimental.

It includes every principle of good engineering that our experience has shown to make for maximum power, coupled with silent operation and freedom from annoying troubles. We have failed of our intentions if we have not produced a motor that will run longer and require less attention than any other.

Our chassis design is very simple and clean. Its light weight, together with its unusually efficient motor, result in a very economical car.

As an instance of this, in our test driving in cross-country runs, we have made over twenty miles to the gallon of gasoline. Of course, in congested city driving, the mileage will not be so high.

Average tire mileage can be expected to exceed 15,000 miles. In our extensive experimental driving of this new car, we have had some tires in fair condition at the end of 25,000 miles.

It is an agreeable car to operate, having the easiest possible steering, the lightest clutch action, the shortest turning radius and, we believe, all those qualities that you would like to have in a light-weight car for general purposes.

The workmanship and finish are Packard throughout.

Packard

The greatest obtainable luxury, the maximum power, and the ultimate in road-ability, must always be found in the large car. That is the field in which the Packard Twin Six will always be dominant.

In this new car we have not attempted to compete in that field, but rather to produce an active, easily-operated, high-grade, light car, with all the elements of efficiency, economy of operation and, above all, long life.

There are Packard cars today, designed years ago, that are nearing the half-million mark in miles traveled.

The new Single Six is also, we confidently believe, a TEN-YEAR CAR.

The price of the Touring Car is $3640 at Detroit.

PACKARD MOTOR CAR COMPANY, *Detroit*

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 14

NEW YORK, OCTOBER 2, 1920

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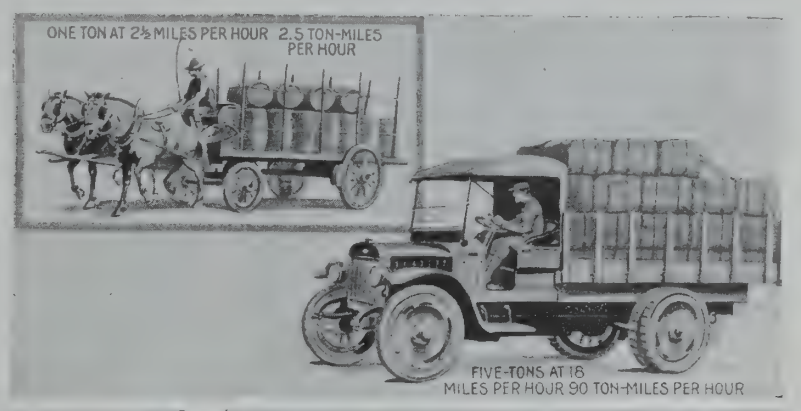


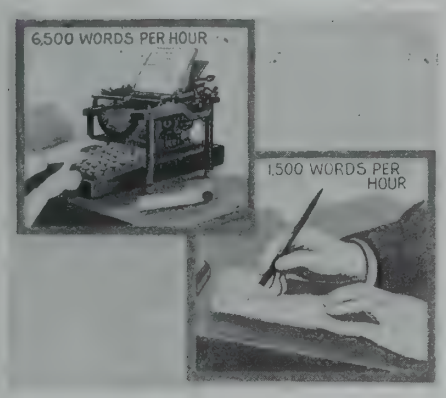


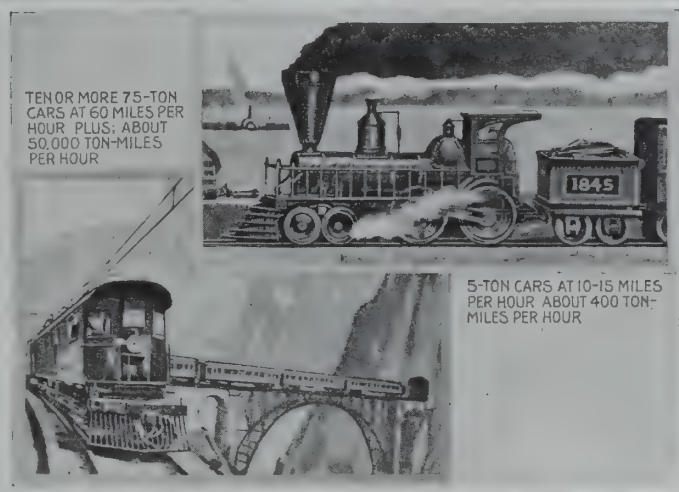


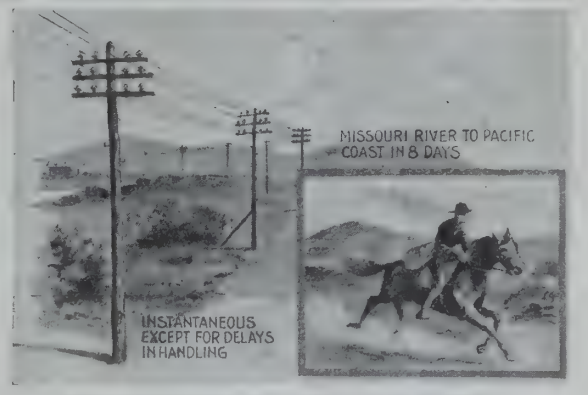

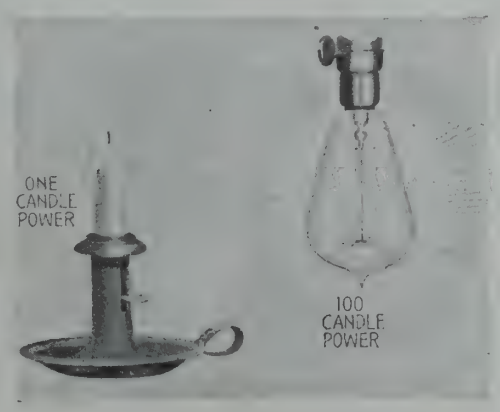

**REPRESENTATIVE PROGRESS OF THE PAST SEVENTY-FIVE YEARS**

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## The Future as Suggested by Developments of the Past Seventy-five Years

INEVITABLY, after such an extensive retrospect of the fields of practical science as we have made in this commemoration of the 75th anniversary of the founding of the SCIENTIFIC AMERICAN, the thoughts of many of us will turn to the future. An outstanding impression left by a perusal of the early volumes of the SCIENTIFIC AMERICAN is the surprisingly large number of forecasts which the passage of the years has shown to be well founded, and we may find some not altogether unprofitable diversion in using the present opportunity to turn from the accomplishments of the past to possible developments of the future.

### Civil Engineering

The profession of civil engineering has been so long established and has proceeded along such definite lines, that the future will probably witness no radical changes either in its principles or practice. The outstanding feature will be the scale on which the civil engineer, thanks to improvements in machinery and general appliances, will attack and put through works of unprecedented magnitude. The construction of the North River Bridge, now assured, will be followed ultimately by the building of a few other long-span bridges of equal or greater magnitude, such, for instance as a 4,000-foot span across the waters of the Golden Gate at San Francisco, another great cantilever bridge connecting Oakland with that city, and the proposed bridge at Detroit across the Detroit River. Where bridging is impossible, resort will be had to tunnelling, and it is probable that the next decade will see the completion of the 21-mile Channel tunnel, to be followed by one between Scotland and Ireland; while he would be a bold prophet who denied the possibility of devising methods by which a subaqueous crossing of the Straits of Gibraltar will be worked out, in spite of the depth of water and the unfavorable condition of the underlying material. In this connection, it is safe to predict that the ugly, noisy and distracting elevated railways will be banished from our city streets and placed underground, and that the imminence of a deadlock in surface transportation will lead in congested centers, to the double-decking of streets, with the separation of light and heavy traffic.

The rate at which we are using up our supplies of raw materials, in the shape of iron ores for the production of a sufficiency of steel, will become, if it has not already become, a serious problem. We may have to turn to other materials, and it is possible that a workable substitute, for certain kinds of structural work, will be found in the direction of improved aluminum alloys, with a lower ratio of bulk to strength and of lower cost.

The future will see a great development of both barge and ship canals—barge canals for the carriage of commodities in bulk which require no great haste in transit, and ship canals to shorten sea travel, or, as in the case of the proposed ship canal from the Lakes to the Atlantic, to enable freight to be carried from interior points to foreign ports without breaking bulk.

### Transportation by Land

As regards transportation the question arises: Will the steam railroad continue to hold the primary position in the transport of passengers and freight? So far as speed and carrying capacity are concerned, they seem to have about reached the limit. The outside dimensions of mammoth locomotives, as represented by the "Virginian," are limited by the height and width of permanent structures. The steel Pullman weighing from seventy-five to eighty tons, and the latest steel coal cars of seventy-five tons' capacity, are subject to the same limitations. If rolling stock continues to increase in weight it will be necessary to revise our methods of track construction, and on the trunk lines of the future we may look to see roadbeds with a concrete foundation covered with broken-stone ballast, and laid with rails of from 150 to 200 pounds to the yard. Experience with the 125-pound steel rail now under test by the Pennsylvania Railroad, has shown that the life, both of track and rolling stock, is prolonged by using very heavy rails, of deep section, rolled from a harder steel.

If the railroad is to hold its own with the automobile, the airplane and the dirigible, the steam locomotive must gradually give way to the electric motor. Gradually, and with increasing efficiency, electric traction will be extended in its application, until the time arrives when our whole railroad system will be run from great central and inter-connected power plants, located at the sources of water power and at the mines. A careful estimate of the resulting economies were our whole railroad system electrified, reveals the astonishing fact that 122,500,000 tons of coal would be saved in every twelve months of operation. With the introduction of electric traction and improved track, we may look for an increase in train speed, and concurrently with this there will be an extensive application of the automatic stop. If it be not introduced voluntarily by the railroad companies, legislation, as in the case of the automatic coupler and the airbrake, will render it everywhere obligatory.

The immediate future will witness a keen competition between the automobile and the railroad; but this will ultimately give way to a well adjusted coöperation, as it comes to be realized that the one is the complement of the other. The main highways of the future will be of concrete construction. There will be a great increase in motor bus travel, and the bus will be developed until the passenger may make his journey over the highways with as much comfort and convenience as he now enjoys on the steam railroad. Ultimately, the "trunk" highways, if we may borrow a railroad term, will be widened out to accommodate four vehicles abreast, motor-truck traffic occupying the center, and fast passenger traffic the outside of the roadbed. It will not be many years before the pneumatic tire will be in universal use for motor-truck service. The motor of the future will be multi-cylindered, sixes and eights predominating; engine weights will be reduced; and power will be sought in high speed of revolution.

Apparently the only limit to the growth of the automobile will be the question of fuel supply. At the present rate of consumption, it is certain that before another seventy-five years have passed, some moderate-priced substitute for gasoline must be found. Otherwise the use of the automobile will have to be greatly curtailed.

### Transportation by Sea

When we come to the question of travel by sea, we can speak with more certainty of the developments of the future. It is probable that in such ships as the "Leviathan" and the "Aquitania," we have reached the limit of size and luxuriance. For many years the steamship companies have claimed that these ships are profitable only as advertisements, and it is well understood that the best revenue earners and, in some respects, the most comfortable ships are vessels of the so-called intermediate type, which can carry a large passenger list and a big load of freight and maintain a speed of sixteen to eighteen knots. Not for many decades to come, if ever, will the Atlantic see a repetition of the speed contest for the famous "Blue Ribbon of the Atlantic." If such competition should occur again, it will be between boats of a special type, of moderate size, carrying no freight and only first-class passengers, and charging sufficiently high rates to cover the great cost of operation. If any firm wished to do so, it would be perfectly possible to build a turbine-driven, 35-knot transatlantic liner provided with limited and extremely high-priced accommodations. In the immediate future there will be an increasing use of both the electric and the geared drive, and if the economies claimed for the electric drive on our warships can be realized in the merchant service, the electric drive must ultimately become the universal type. Meanwhile, as the problems of the oil engine are mastered and the size of the individual cylinder increases, there will be a corresponding increase in the number of oil-driven ships. There is everything to be said in favor of the marine oil engine, and practically nothing against it. The oil engine, because of its many economies will ultimately drive out the marine steam engine, and nothing short of the giving out of the oil supply can stop its progress. When the oil wells of the world run dry, the motor-driven ship will have to give place to the steamship with its coal-fired boiler.

### Aviation

IT is quite possible that the future historian will set down the present year as marking a new era in the history of aviation—the era of metal construction. As an advocate from the very first of the monoplane as against the multi-winged type, we are gratified to note that, so far as America is concerned, two of her entries for the approaching international cup contest are of the monoplane type, and that the most important of the new airplane postal routes, that from New York to San Francisco, is being operated by all-metal monoplanes. The monoplane is ideal for high speed, and because of its lower head resistance, or drift, it is the most economical type at any speed. It has been built in fairly large sizes, although, for the present, it seems likely that in the largest airplanes, recourse will be had to the biplane type. Excellent progress is being made in the development of a more effective form of wing, and unquestionably the airplane of the future will be capable of changing the angle of incidence during flight. When this has been done, the difficulties and dangers of taking off and landing will be reduced to a minimum, and the pilot will have a wider range of choice for a landing place in cases of forced descent. Similarly, in the near future we look to see a thoroughly reliable variable pitch propeller put upon the market. Results obtained with this device at the Army Flying Grounds at McCook Field are very encouraging; for it has been found practicable to change the pitch of the propeller to suit the altitude, and also to reverse it entirely at the moment of landing, thereby securing a braking effect, so powerful as to bring the machine very quickly to rest after it has reached the ground.

There will be a steady increase in the size both of airplanes and dirigibles. It is now realized that there is no inherent disadvantage, as was at first supposed, resulting from increase of size in the airplane. At the present time a seaplane is under construction which has a wing spread of nearly 250 feet; whose weight is over 50 tons, and whose radius is over 4,000 miles on one filling of the fuel tanks. The boat is of such size that full stateroom accommodation is provided for a considerable complement of passengers and crew. This is an enormous advance at one stride, and suggests that future airplanes and seaplanes may ultimately rival the smaller ocean-going steamships in dimensions. Reliability will be assured by a multiplicity of engines, the flying boat above mentioned having no less than eight, with a total capacity of nearly 5,000 horse-power As far as the dirigible is concerned, any increase in dimensions brings with it a greater relative increase in carrying power and all-around efficiency. Now that the question of landing has been solved by the provision of mooring towers, the risk of landing, even in heavy weather, has been eliminated. The flight of R-34 last summer from England to America and back has established the feasibility of trans-oceanic travel, and the last machine to be completed, R-80, in its recent trial trips has shown great improvement in control and maneuverability over R-34. This latest of the dirigibles has a cruising radius of 6,400 miles and a maximum speed of 65 miles per hour. Aerial travel will be

divided between the two types, the dirigible being used for long distance and trans-oceanic travel, while the airplane will be the standard machine on overland routes, where the distances between stops are shorter. Experimental work which is being carried on in this country in producing a steam drive for airplane service has given such promising results, that it is quite possible a combined steam boiler and steam turbine, admirably adapted for the larger machines, will be in extensive use within the next few years. One of the great advantages possessed by steam-driven airplanes would be the absence of the loud exhaust, an improvement which will be especially appreciated by the airplane passenger, and will prove to be of great tactical advantage in naval and military airplane service.

### Pure Science

When the investigator in the field of pure science has unearthed new facts and new principles, it is often possible to predict with some accuracy just what use the inventor will make of these. But prediction in the field of pure science is another matter. The scientist sets forth over an uncharted sea, and the scribe, left behind on the dock, is asked what he may find at the other side of the waters. If the scribe knew, the scientist would not have to make his voyage.

Nevertheless, sometimes the scribe knows something about the ship in which the scientist is sailing, and enough about the waters over which he is to pass to hazard a guess as to his direction. And if one thing seems clearer than anything else when we try to see in what direction the ship of science is heading, it is that the process of generalization, shown on another page to have been the dominant note in scientific progress for the past three-quarters of a century, has by no means reached its culmination. We have but scratched the surface of the discoveries that wait to be made regarding the essential unity of matter and energy, and the direction of major achievement in the science of the next seventy-five years is here clearly outlined. If we are ever to find the way to utilize for our own purposes the vast store of energy locked up in matter, the way will lie through a better understanding of just what the correspondence is between these two entities. More specific than this we cannot be, or we should be steering the ship instead of watching from the shores for its return.

In the field of biology prediction can be more specific. We shall continue to pick up information as to how heredity works, until we shall be pretty well able to determine in advance physical and mental characteristics of animals a long way up the scale from the sand flies to which experiment is so far confined. Doubtless the goal here is the human animal; whether that goal will be attained is a matter of guesswork. If balked in the direct attack, we may at least hope to prevent the production of types running too strongly in the wrong directions physically and mentally.

Every age sees a new science—a whole body of phenomena and of the principles that govern them—developed where previously we had not even been conscious that there was a void in our knowledge. In the eighteenth century it was electricity; in the nineteenth, psychology. In the twentieth, it is the conviction of the SCIENTIFIC AMERICAN that it will be the field to which the rather unsatisfactory name of psychic has been attached.

We make this statement without any reference to the question of personal survival or that of communication with those alleged so to have survived. But the fact can hardly be escaped that there is a growing fund of well authenticated phenomena which are explained by no natural law yet formulated, and which seem to require that we postulate the existence of some force operated, consciously or unconsciously, by the human brain. Nobody, for instance, can deny the phenomenon of hypnosis. No careful person is going to deny categorically the accumulating evidence that there really is some sort of communication between individuals widely separated in space, to which the general name of mind-reading or thought-transferance or telepathy has been provisionally applied. We think we may, without being accused of having fallen victim to the post-war hysteria, suggest that when all cases of fraud and hypnosis have been ruled out, there is a residuum of material demonstrations of an as yet intangible force—things to which the hateful names of spirit-rapping, table-tipping, levitation, etc., must be applied until we get a more respectable term to take their collective place.

On all these grounds we are inclined to predict that there exists a force, operated through action of the human brain, that is capable of producing sensible effects and effects upon another brain. The science of tomorrow will tell us what this force is and will give us a control over it which may turn out to be as complete as our control over the electric impulses which today we shoot through the ether in utter defiance of all the experiment and all the knowledge and all the common sense of a generation ago.

### Applied Electricity

Electricity in the rôle of man's faithful slave is so relatively young that one hesitates to say much regarding its future. Only yesterday Edison was trying all kinds of materials in order to obtain a suitable incandescent lamp filament; Bell was struggling with a toy called the telephone; and several experimenters were entertaining their friends by transporting them about on crude electric cars. And if such remarkable progress has been made in but a few past decades, there is a wonderful future surely for this new art.

In the generation of electricity there will doubtless be progress, but it seems certain that such progress will not be spectacular. The generators of today have attained very high efficiency, and unless some new principle displaces the electro-magnetic type on which our present power plants are based, the generators of tomorrow will merely be larger and of far greater output. This great power will be transmitted thousands of miles, as compared with three or four hundred miles today. There is no doubt but that the problem of long-distance transmission will be solved, and the solution will be in the nature of better insulation and the consequent use of extreme potentials. Better transmission, in turn, will make it possible and feasible to harness the mountain streams that are far removed from civilization. It will also bring about the reduction of coal shipments; for why transport coal hundreds and thousands of miles when it can be burned at the mines to drive generators, and its power can be transmitted electrically to the distant consumer?

The electric furnace is in its infancy. It will reveal many new electro-chemical wonders when its possibilities are developed on a larger scale through the medium of cheaper current. Electric heating too is bound to be extended as current becomes cheaper through the harnessing of water power and the solving of long-distance transmission. Electric cooking on a vast scale only waits for a better rate per kilowatt hour.

In the field of communication we can look forward to great things. The introduction of the vacuum tube—that marvelous offspring of the incandescent lamp—seems to reveal no end of wonders. Engineers and experimenters are daily discovering new uses for the vacuum tube in telephony and radio work. We already have trans-continental telephony, and we may look forward to transatlantic telephony in the no distant future.

Radio communication is a newcomer in the field of applied electricity, yet it is a giant in point of development. True, this method of communication still leaves much to be desired, and it is the missing factors that must be supplied by future workers. Static—electric disturbances of the atmosphere—must soon be eliminated. Further introduction of faster automatic transmitters is certain, so that a tremendous volume of traffic will be handled by a given station, with subsequent reduction in toll rates.

In the field of illumination electricity has found a ready place. Nothing else can compete with it. And there seems no reason to doubt the ever-increasing use of electricity for illumination, especially when we are already facing serious shortage of heavy oils and other ingredients entering into the manufacture of illuminating gas. We have the one-half watt per candlepower lamp now; is it not safe to prophesy the one-tenth watt per candlepower lamp in the future?

The transmission of photographs over wires and by wireless; seeing the image of the person to whom you are speaking over the telephone; subscribing to concerts and motion pictures for the home, the service being distributed over the usual telephone lines by a central studio; frictionless electro-magnetic transportation systems that will attain hundreds of miles per hour; the transmission of electricity by wireless—all these things seem visionary today, but certainly no more so than our present attainments would have seemed to our forefathers of 1845.

### Industrial Progress

Whatever may be the reason for the present shortage of labor, one thing seems certain, and that is the permancy of labor shortage or, to put it another way, the continuation of high labor costs. For it is not so much the number of unfortunates killed and maimed in the late war, nor again the need for replenishing the world's depleted stores that is responsible for the labor shortage, as it is the question of higher standards of living demanded by workingmen the world over.

So it has come about that workmen, who a few decades ago looked upon all machinery as evil competitors that were being introduced for the purpose of taking that much of their livelihood away from them, are now insisting on the use of machinery wherever possible. This spirit is on the increase. Laborers today resent doing work by hand that can be done by machinery to better advantage; for they realize that better and bigger production must mean an all-round rise in the standards of living.

The era of quantity production is already well under way, but more may be expected of it as the years go by. With labor co-operating in the development and introduction of such processes and machinery, we shall have more labor available for a variety of tasks which today must go unattended through lack of spare hands. Already we have attained high efficiency in many of our leading factories, where the men do not even have to move away from their bench in order to work on thousands of parts and assemblies which come and go from their hands in a steady stream. Automatic conveyors are going to play a tremendous rôle in future industry; we have only begun to make use of these remarkable labor savers. Automatic machinery is still in its infancy, despite our seemingly wonderful attainments. We are doing wonders in drop-forging, casting, and so on.

But where will these products be sold? Will the market not be saturated? Is there not a serious danger of over-production?

It must be remembered that our world—that is, the world with which we do business—is still small. The day is coming when we shall be called upon to provide the Africans and the Asiatics with all manner of useful things, and with the vast populations of those neglected continents as potential buyers of our products, we shall require far greater industries than we have today. Greater production will lead to increased commerce, and we shall have to conduct international trading on a vast scale in order to dispose of our machine-made products. In exchange we shall obtain natural products and other things which are still classed as luxuries because of the limited trade of today. All of which will go far to raise the standards of living throughout the world.

There is only one threat in the way of industrial progress, and that is fuel shortage. Coal is becoming less plentiful, as the decades go by. Oil is becoming scarcer. The future will have to call into play a number of substitutes for these staples of our present life. It may be that alcohol will prove the best fuel to carry on the world's business, for alcohol can be made from a variety of inexpensive ingredients by a simple process. It has been pointed out that an almost unlimited supply of alcohol is available in the tropical jungles, where the prolific vegetation can readily be treated if suitable alcohol-producing plants are conventiently installed. Then there are the water power resources to help out.

Industrial progress must continue, and its future is larger and better than the present. Our problems of today are but those of a transitory period, which, when gradually solved, must lead to better conditions for manufacturer, workingman, and consumer alike.

# Seventy-Five Years of Invention

## A Record of Progress Decade by Decade

### 1845–1855

IN 1846 Richard Marsh Hoe made valuable contributions to printing machinery. He developed the type revolving press of the period in which a single form of type was carried beneath four, six, eight, or ten printing cylinders and used to print upon a sheet borne by each. Later Stephen Tucker converted this into the perfecting press (one that printed on both sides of the sheet). Eventually he adapted his machine to print upon a web or endless sheet of paper.

Of the improvements in civil engineering that deserve to be noted, it must be mentioned that in 1846 the French engineer Fauvelle invented the process of boring by forcing water under high pressure into a hollow boring tool. In 1852 Merriweather, a California miner, invented the hydraulic system of mining gold.

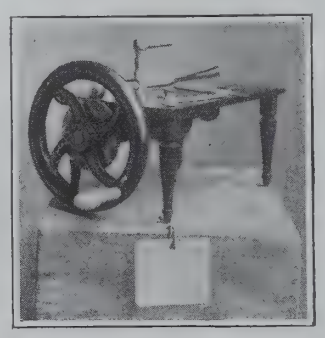
The modern bicycle seems to have had its origin in 1854. P. H. Fischer, a mechanic of Schweinfurt, Germany, added pedal cranks to the velocipede. Ernest Michaux hit upon the same idea in 1855.

In steam engineering the most notable achievement was undoubtedly George H. Corliss's invention, in 1848, of his famous valve gear, patented in 1849. The first steam boiler with horizontal iron tubes was constructed in 1855 by Julien Belleville. Wilcox built his first steam water-tube boiler with inclined water tubes in the same year. In the year 1840 Henry R. Worthington conceived the idea of applying steam to the propulsion of canal boats and in that connection invented the independent single direct-action boiler steam pump—beginning manufacture in 1845.

This decade marks the beginning of the high explosive industry; in 1845 Christian Friedrich Schoenbein discovered guncotton.

Industrially, by far the most important invention of the decade was the Bessemer process of making steel, *i. e.*, the direct conversion of molten cast iron into steel by blowing air into the molten mass. Henry Bessemer invented the process in 1855.

During this decade Stephen Fitch furnished a screw cutting lathe with a number of tools set in a holder which could be revolved to bring them successively to the work. This was the first turret lathe. In 1855 the Jones and Samson Machine Company produced a turret lathe in which the turret was turned automatically. The milling machine, originally invented by Eli Whitney, of cotton gin fame, in 1815, was further developed in 1853 by Frederick W. Howe, and this was followed in 1854 by what has since been known as the Lincoln miller, designed by F. A. Pratt of the Pratt & Whitney Company.



**Sewing machine patented by A. B. Wilson in 1850**

On September 10, 1846, Elias Howe received a patent for his epoch-making sewing machine. The features that made Howe's machine a success were a needle with the eye at the point, a shuttle operating beneath the cloth to form the lock stitch, and an automatic feed. To Allen B. Wilson we are indebted for the rotating hook and the four-motion feed. His first machine was built during the spring of 1849. In the same year he built a second and better machine which he brought to New York in order that he could exhibit it to the Editor of the SCIENTIFIC AMERICAN. In 1851 Wilson patented his famous rotating hook, which performs the functions of a shuttle by seizing the upper thread and throwing its loop over a circular bobbin containing the under thread. In 1859 Gibbs, a Virginia farmer, saw in the SCIENTIFIC AMERICAN a picture of a sewing machine. The working of the apparatus was very plain down to the moment when the needle perforates the cloth, and he fell into the habit of musing upon the course of events after the point of the needle was lost to view. The result of his cogitations, aided by infinite whittling, was the ingenious little revolving hook, which constitutes the peculiarity of the Willcox & Gibbs machine. In 1851 Isaac Merritt Singer brought into the business a new machine. The novelties consisted in the circular feed wheel below the cloth plate, which had a serrated periphery projecting slightly above the plate, and was fed by a rock shaft and pawl; a thread controller; and the use of gear wheels and shafting to transmit the power from the hand wheel to the two countershafts for working the vertical needle and the shuttle. Singer was also the first to introduce foot power in place of the hand-driven crank wheel. John Brooks Nichols, a Lynn shoemaker, about the year 1851 adapted the Howe sewing machine to sew the uppers of shoes.

The first power elevator was installed in 1852 by Elisha Graves Otis; and a few years later he exhibited at the Crystal Palace, in New York, the first elevator with a safety device to prevent the car from falling when the cable broke. The first exclusive passenger elevator operated by steam was installed in the Fifth Avenue Hotel in 1859 by Otis Tufts.

The efforts of inventors to produce a telegraphic printing machine gave impetus to the idea of a writing machine. In 1843, Charles Thurber of Worcester, Mass., patented a slow typewriter. The model was interesting as effecting the letter spacing by longitudinal motion of a platen—a principle which is a feature of all modern machines. In 1847 Dr. Francis patented a typewriter in which a motion similar to that of a piano hammer was employed to throw up the types, which were arranged in a circle, thus bringing them to a common center.

**Reciprocating bar motor of Joseph Henry, patented in 1831**

In 1831 Cyrus H. McCormick of Virginia built the first practical grain harvesting machine. But it was not until 1845, the year in which the SCIENTIFIC AMERICAN was established, that the reaper was really introduced. It contained the essential elements that have been found in every grain harvester that has proved a success from that day to this. The most important feature was the sickle consisting of a bar with projecting fingers through which a knife reciprocated. The grain, forced to the sickle by a reel, was cut and dropped upon a platform. A man, walking alongside the platform, removed the grain with a rake. The next improvement was the addition of a seat for the man who raked the grain. In 1849 Jacob J. and Henry F. Mann patented a machine having a series of endless bands for carrying the grain, after it had been cut and reeled upon these bands, to the side of the machine, where it accumulated in a receptacle until a sufficient amount had been gathered to form a bundle, when the operator dumped the receptacle, leaving the gavel upon the ground. In 1850 Homer Atkins invented a device for giving a reciprocating, intermittent motion to a rake, in order to deposit the grain upon the ground, after it had been cut and reeled upon the platform. In the summer of 1850 Augustus Adams and J. T. Gifford of Elgin, Ill., built probably the first hand binding harvesting machine.

### 1855–1865

The decade is notable for the important work done in laying the foundation of modern electrical engineering. The direct current motor, and the storage battery belong to this period.

The first modern coke oven of the by-product recovery type was built in 1856 by Carvès at Lebrun, Commentry. The principle of centrifugal casting in the production of iron and steel, although proposed as early as 1839, was practically carried out by Henry Bessemer in 1856.

The first modern hydraulic press was built in 1858 by Robinson and Gotham for iron works, but hydraulic press forging was substituted for the hammer in 1861 by John Haswell. Haswell's press was improved by Reiner Daelen in 1865 by applying steam pressure directly, thus dispensing with a pump and an accumulator.

Most important in its general industrial effect was the invention of the regenerative gas furnace by Friedrich and William Siemens in 1856.

On August 28th, 1859, G. L. Drake, while driving an artesian well struck oil. The first really successful pipe line was laid by Samuel Van Sycle in 1865 between Pithole and Miller's Farm.

The modern ammonia absorption ice machine was devised in 1860 by the French engineer, F. P. E. Carre. Improved by Reis (1870) and by Koch and Haberland (1871), this machine held its own until the compression apparatus was brought to a high state of efficiency. A closed cold-air or refrigerating machine was built in 1862 by A. C. Kirck.

Finding that his early pump lacked smoothness in operation, Worthington developed the duplex pump, which he patented in 1859. Another inventor who did much to improve the pump was George F. Blake. In 1862 he installed and operated his first single direct-action pump. In the same period belongs the development of the Knowles pump. In 1863 Holly constructed the first water-works plant in Lockport, N. Y., consisting of a rotary pump, turbine water wheel, about one mile of water main and twelve fire hydrants.

In steam engineering we must note that in 1858 John Elder combined the compound steam engine with the surface condenser, and thus devised a type of double-expansion compound engine, which has markedly influenced the development of marine engineering.

In 1860 Lenoir patented his historic gas engine, in which he actually used electrical ignition.

In 1861 Joseph R. Brown developed the universal milling machine. Cylindrical grinding began in this decade and in 1864 a grinding machine was put on the market by the Brown and Sharpe Company.

The decade brought forth the Solvay soda process, invented by the Belgian chemist and engineer, Ernest Solvay.

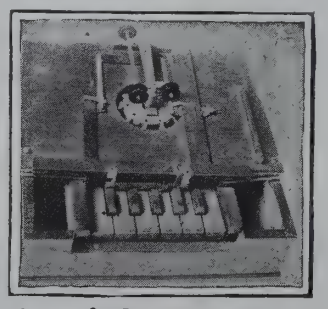
The type revolving printing press was in general use until Bullock introduced his stereotype perfecting press in this decade. This cut the sheets from a web before they went to the printing cylinders. Between 1862 and 1864 Andrew Campbell put out the first cheap cylinder press. Campbell then built his two-revolution printing machine (1865-1870), which has since become the standard press throughout the world.

In 1857 Snell and Bartlett patented their mechanical let-off for warps, an important improvement in textile machinery. The principle of this warp let-off was to actuate the large warp beam containing the warps at the rear of the loom by a ratchet and pawl connection with the oscillating lay, the movement of this ratchet and pawl-actuating mechanism being controlled by the tension of the warps.

It was in this decade that George Pullman introduced the Pullman car. In 1867 he devised the combined drawing-room car, which could be converted into a sleeper at night.

Bushnell in 1775 built the first practical submarine boat, and Fulton in 1801 employed the usual vertical rudder and a horizontal rudder. Although Bauer, a Bavarian, constructed a submarine vessel in 1850, no substantial advance was made until Bougeois and Brun completed "Le Plongeur" in 1864.

The year 1858 marks the beginning of the wonderful modern shoe machine industry, for then it was that Lyman R. Blake invented a machine which sewed the soles of shoes to the uppers. In 1862 Auguste Destouy invented a machine with a curved needle to sew turn shoes, which was improved by Daniel Mills in 1869. This machine was adapted by Charles Goodyear to the sewing of welts. Goodyear patented his machine in 1871 and 1875.



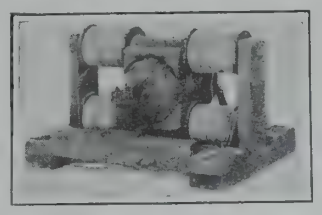
**One of the pioneer typewriters, patented in 1868**

A marked advance in typewriting machines was made in 1856 by Mr. Alfred Ely Beach, Editor of the SCIENTIFIC AMERICAN and one of the founders of Munn & Co. This machine was primarily intended for the printing of embossed letters for the blind, but could also be adapted to the general uses of the typewriter. During the winter of 1866-1867 C. Latham Sholes, a printer and editor by trade, and Samuel W. Soulé, also a printer, inventor and farmer, were engaged together in developing a machine for serially numbering the pages of blankbooks. Carlos Glidden became interested in Soulé's machine and suggested the idea of devising a mechanism which would write letters and words. In the following year a copy of the SCIENTIFIC AMERICAN fell into the hands of Glidden. It described a machine called the pterotype (winged type), invented by John Pratt, which was designed to do just what Glidden had suggested. This article was brought to the attention of Sholes. Glidden, Soulé, and Sholes eventually formed a combination to

develop a practical machine. By September of that year the first machine had been made. James Densmore of Meadville, Pa., was attracted to the new enterprise and purchased an interest in it. He urged further improvements, pointing out many defects. Soulé and Glidden dropped out of the enterprise and left it entirely to Sholes and Densmore. By 1873 the machine had been developed so far that it was felt it could be manufactured, and with that end in view Densmore came, in 1873, to the gun factory of E. Remington & Sons of Ilion, N. Y. At the factory of the Remingtons the machine was further developed and was finally placed upon the market about the middle of 1874.

### 1865–1875

Modern electrical engineering is placed on a sure footing in this decade; for we find not only the dynamo and the motor vastly improved, but new applications of the electrical current made on every side.



**Early type of dynamo for supply current to arc lamps**

Sylvanus D. Locke, in 1873, after associating himself with Walter A. Wood, built and sold probably the first automatic self-binding harvester that was ever put upon the market. The use of wire as a binding material met with opposition, and the inventors turned their attention to perfecting an attachment that would bind with cord; and to Marquis L. Gorham of Rockford, Ill., who built a successful cord binder and had it at work in the harvest field in 1874, must be given the credit of producing the first successful automatic self-sizing binder.

Jacob Reese, an American inventor, in 1875, built a machine for cutting iron and steel with rapidly rotating disks of soft iron. In 1872 A. Brandon developed a file-making machine, which, in imitation of hand labor, applied chisel and hammer separately. However, it could be used only for making flat files. It was improved by Maurice Mondon of London, in 1874, so that convex filing surfaces could be made. The modern machine, however, was invented by Disston of Philadelphia. The idea of rolling instead of forging files was carried out in 1864 by B. H. Dodge, who constructed a machine for that purpose. In 1866 William Sellers and Company developed an automatic machine for cutting gears which operated on the formed tool system. The first commercial automatic machine, however, was produced by Brown and Sharpe in 1877.

George Bedson of Manchester in 1867 invented a continuous wire rolling mill. He was the first to roll out metal bars weighing one hundred pounds into wire at the rate of eleven tons a day.

Railroading received a great impetus by George Westinghouse's invention of the air brake.

An invention which attracted but little attention at the time, but which was the beginning of the reinforced concrete industry appeared in 1867. Then it was that Jose Monier patented a method of making flower pots out of cement with a reinforcement of iron netting.

Benjamin C. Tilghman invented the sand blast in 1871 for producing mat glass. His invention was afterward introduced into the iron and stone industries. Tilghman is also to be credited with the invention of chemical wood pulp. After he had pointed the way, George Fry and his collaborator, Ekman, developed at Bergvick, Sweden, the process of separating the cellulose of wood by boiling it under pressure in an aqueous solution of sulfur dioxide in which magnesium sulfite was dissolved.

In 1862 Joseph Moore of San Francisco brought out the California stamp mill, which became of great importance in mining. The dry concentrator in which air is employed for the separation of minerals was introduced in 1868 by Stephen R. Krom. Another improvement was Dingey's mineral mill (1872) consisting of a slowly revolving horizontal slotted plate over which four notched disks rotated in the opposite direction.

A rotary knitting machine was built by Lamb of Valparaiso, Indiana, in 1866. This machine was afterward improved by Dubied and Watteville. It made a stocking without any seam whatever.

The first great modern vacuum ice machine was exhibited by Edward Carré at the Paris Exposition of 1867. In this machine water was used as the vaporizing fluid and concentrated sulfuric acid as the absorbing fluid.

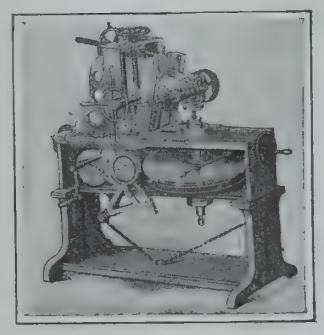
In 1873 Lowe and White invented the modern water gas process. Another improvement in the art of illumination was that of C. Tessié du Motay, who invented the zircon light in 1867, in which a pencil of zircon was heated to incandescence in a gas blowpipe. Clammond, in 1872, hit upon the idea of bringing magnesia to incandescence in a blowpipe. In a sense he was the forerunner of Welsbach.

J. S. Hyatt discovered in 1869 that camphor is a solvent for various kinds of nitrocellulose and thus established the great modern celluloid industry.

Dynamite was invented in 1867 by Alfred Nobel. He discovered the extraordinary absorptive powers of the infusorial earths for nitroglycerine.

Madison improved the bicycle in 1867 by providing it with radial wire spokes.

On September 5th, 1865, Alfred Ely Beach, Editor of the SCIENTIFIC AMERICAN, patented a plan for conveying letters and parcels by mechanical means directly to a central post office from a lamp-post letter-box. In the following year he learned of the success of experimental pneumatic tubes in Great Britain, through which small cars carrying merchandise and persons in a sitting position were successfully operated. Thereupon he invented a plan of dispatching letters pneumatically. X-shaped revolvable valves in lamp-posts were intended to catch the letters as they were dropped from above, and to hold them until the pneumatic car came along, into which they were emptied automatically. A pneumatic subway under Broadway was the next development, the modern tunneling shield, suggested as early as 1824 by Brunel, being practically applied. The shield was pushed forward in a modern way by a series of hydraulic rams, which system Mr. Beach patented June 8th, 1869. With this shield a tunnel was driven under Broadway from Warren Street to Murray Street. A car was propelled through this tunnel by means of a blower, the blower being reversed so as to suck the car back when it had reached the end of its travel.



**Pioneer gear-cutting machine of Joseph R. Brown, 1885**

Almost simultaneously with the steam elevator appeared the hydraulic elevator, which in its simplest form was a ram located under the carrying platform, which was moved up and down by water under pressure, working in a closed cylinder. This system of operation was first put into practical use in 1872. Following this type came the geared hydraulic, in which the ram became a piston, which was attached to the moving element of a system of multiplying sheaves, over which the elevator cables were passed, thus enabling a short cylinder to effect a high lift.

### 1875–1885

This was primarily a decade of electrical invention. Edison's incandescent lamp and Bell's telephone were the outstanding inventions of the period.

In 1877 the phonograph appeared, one of Edison's most original and brilliant inventions. Its first public demonstration was in the office of the SCIENTIFIC AMERICAN toward the end of the same year.

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**Recording the voice of the American Indian for posterity**

In 1883 Sir Hiram Maxim invented his automatic (self-loading) machine gun, in which he utilized the force of the recoil to reload the weapon as well as to fire it automatically. Most modern machine guns have been based upon this early weapon of Maxim's.

Andrew Campbell in 1875 developed a press which used curved stereotype plates and printed on both sides of the web itself. Later Campbell added a folding machine. Next he built a double printing machine, each half of which contributed a perfected web to a folding machine common to both, whereby he was able to turn out an eight-page paper. Stephen D. Tucker, an inventor in the employe of Hoe, also invented a folder. He applied for a patent (1875); Campbell did not. Hence, one of the most valuable improvements in printing presses fell to the Hoes. At about the same time Tucker invented the collecting cylinder, by means of which the product of one circumferential half of a printing cylinder may be transposed upon the product of the following half, and thus the two brought together as a single product. Two Englishmen, Anthony and Rose, conceived the idea of splitting a web of paper into two longitudinal halves and transferring one-half over and upon the other by means of deflecting bars, so that the right-hand product of a printing cylinder could be superposed upon its left-hand product and the two made up into one. This invention is now included in all double-width newspaper printing presses. Another improvement came when Ford patented a means for running the product of two printing machines into one folding machine. Crowell, an ingenious Yankee skipper, invented the longitudinal folder, by which a web may be folded longitudinally while on the run and still in web form. About the same time (1879-1889) he conceived the idea of the rotary fly. This was the last device necessary to the creation of a 24,000-copies-an-hour printing press, and when it was introduced (in the early eighties) the rotary newspaper printing press in all its elements became the machine it is today.

The universal grinder which has been in process of development for a number of years at the hands of Joseph R. Brown was exhibited at the Centennial Exposition. The generating system of gear cutting was invented by Hugo Bilgram in 1881.

Important progress in metallurgy was made. After M. J. Holway had made experiments in bessemerizing copper (1877-1878), following the experiments of Semennikow, M. J. Brown of Sheffield succeeded in blowing Rio Tinto ores in Bessemer converters. The modern Otto by-product coke oven, an improvement on that of Bauer and Hoffmann, was introduced in 1880. Alexander and MacGosh invented the so-called Gartsherrie process for obtaining ammonia and tar from blast furnace gases.

The first two-cycle gas engine appeared in 1879. It was the invention of Clerk and was distinguished by its separate compression pump, which charged the working chamber and also acted as a scavenger. The first gas engine for locomotives was built in the same year by Marcel Deprez. The gas was compressed in a suitable container, and after having been allowed to work expansively like steam, was mixed with air, exploded, and thus made to do work again. In 1880 the French engineer, Serpollet, constructed a steam engine for tram cars employing a flash boiler. But the crowning invention in engines was the steam turbine. In 1884 Charles Algernon Parsons of Newcastle-on-the-Tyne invented his multi-cellular turbine, which utilizes steam first on the action and then on the reaction principle.

In the same year Pelton, an American, invented the Pelton wheel, in which cups are used instead of blades, the cups being so designed that they utilize the force of the impinging water to the utmost limit of possibility.

For many decades inventors had endeavored to supply a satisfactory machine for setting type. It was not until 1888 that such a machine was invented. It was the invention of Ottmar Mergenthaler, and it worked on an entirely new principle. Instead of setting the types and after their use distributing them among their respective receptacles, Mergenthaler employed the type-matrices, and from these cast, as a single piece, a line of characters. Hence, his machine was called a "linotype." On the heels of the linotype came another device—the "monotype," invented by Lanston. This monotype consisted of two independent mechanisms, the one a keyboard by means of which the operator was enabled rapidly to perforate a paper ribbon with holes which represent characters, and the other a type-casting mechanism controlled by the perforated ribbon.

The first really successful modern volatile hydrocarbon automobile had its origin in this decade, as described elsewhere in this issue.

In 1876 J. P. Holland built a submarine vessel (the "Fenian Ram"), following the Fulton system of control by vertical and horizontal rudders. She was fitted with an air gun which could be discharged under water, and was probably the first submarine torpedo boat, if we give the word torpedo its largest significance.

In 1880 Alexander E. Brown installed the first mechanical ore unloader to take ore from the hold of a boat and deliver it either to cars or to stock piles without rehandling.

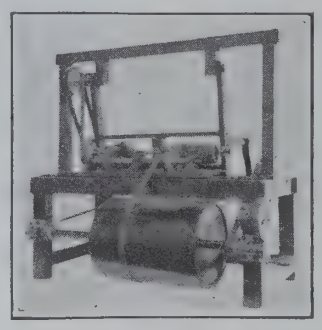
During this period the Ekman paper-pulp process was markedly developed. Mechanical difficulties surrounded the operation from the start, though the quality of pulp produced was excellent. The digesters in which the wood was cooked were lined with lead and the heat developed in the acid liquor proved to be exceedingly disturbing, as while the lead expanded during the application of heat, it did not contract again

when cold. The difficulty was overcome by the invention of a digester lining composed of heavy cement backing, faced with brick, the latter being pointed with litharge and glycerin.

Perhaps the most important invention in pulp-making processes, especially in view of recent work in the utilization of waste wood, dates from 1883, when Dahl introduced the sulfate process for the treatment of straw, a modification of which is now applied to the production of pulp from coniferous woods that are not amenable to other treatment.

### 1885–1895

The turret lathe with flat style of turret was invented by James Hartness in 1889 and was further improved in 1891. In 1894 Conrad M. Conradson invented a lathe with hollow spindle through which the work could be fed to the machine.



**Blanchard duplicating lathe built in 1843**

The year 1893 marks the publication of Rudolf Diesel's "Theory and Construction of a Rational Heat Motor," in which he set forth the principles of the well-known Diesel engine. In 1887 Gustaf de Laval invented his high-speed steam turbine, in which the potential energy of the high-pressure steam is transformed into kinetic energy in a single stage and imparted to the shaft. In the same year he designed his centrifugal cream separator, which ever since has been widely used throughout the dairy industry.

In 1894 Bénier patented the suction producer-gas plant in which the motor is made to draw its gas from the generator, thus producing a depression in the generator which is filled by air below atmospheric pressure. This air is mixed with steam and forms new gas in passing over the layer of glowing fuel.

The first attempt to use compressed illuminating gas was made by Julius Pintsch in 1891. His system, properly developed, made it possible to illuminate railway trains with gas.

The famous McArthur-Forrest cyanide process, which has been of immense importance in gold mining, was brought out in 1887 by Robert William Forrest, William Forrest, and John McArthur. These investigators found that the effect of potassium cyanide depends upon the weakness of the solution. The gold mines of the Transvaal took up the process almost as soon as it was introduced.

The possibilities of the electrical furnace were never before so brilliantly revealed as in this decade. In 1862 Woehler discovered that water acting on calcium carbide would produce acetylene. The next step was to make calcium carbide cheaply. An early attempt with the electric furnace was that of Henri Moissan (1892), who succeeded in making calcium carbide out of marble and sugar carbon. Then came Thomas L. Willson, to whom the credit is really due of placing the manufacture of calcium carbide upon an industrial basis, which he achieved in 1892 in coöperation with Dickerson. Paul Héroult constructed the cathode furnace (1887) for uninterrupted operation and thus becomes the founder of the electrometallurgy of aluminum according to the smelting method. Edward G. Acheson succeeded in 1892 in making silicon carbide in the electric furnace—an abrasive which has been known to the trade as carborundum. He also obtained artificial graphite in the electric furnace for the first time.

The first commercially successful process for making artificial silk was that brought out in 1885 by Chardonnet, who squirted nitro-cellulose under pressure through small holes in water, alcohol, chloroform or the like, the threads congealing at once.

John B. Dunlop, a dentist of Dublin, Ireland, invented the pneumatic tire in 1890, as we know it today. He seems to have been quite unaware of Thomson's pioneer work in the same line (1846).

Edison's experimental success with his tinfoil phonograph in 1877 proved the starting point of much valuable investigation in sound production by himself and others. In 1886 Dr. Chichester Bell and Charles Sumner Tainter patented their method of recording and reproducing sounds by engraving a wax or wax-like substance, thus producing records that could be removed from the machine, handled and transported. In 1887, Emile Berliner invented the gramophone or disk graphophone and worked out for practical use the system of duplicating disk records, which has been in use ever since.

Goubet of France built several submarine torpedo boats between 1885 and 1890. The novel feature was his propeller, which worked on a universal joint so that it could be changed as to the direction of thrust. It took the place of vertical and horizontal rudders. Prof. Josiah Tuck carried on experiments with his submarine ("Peacemaker") in the Hudson River in 1885, using caustic soda to generate steam. His boat had a water lock through which a man, clad in a diving suit, could pass. Several other submarines were built in Europe during this period. The most successful of these was perhaps the "Gymnote" built in France after the designs of Dupuy de Lome and Gustave Zédé.

In 1893 the United States Navy advertised for bids for the construction of a submarine. J. P. Holland, George C. Baker, and Simon Lake handed in plans. Baker's design was based on the performance of a vessel he had experimented with in 1892. Holland submitted plans for a steam vessel of the diving type with horizontal rudders at the stern for changing the inclination of the vessel, as first used by Fulton. Lake submitted a design for a vessel with an inner and outer hull, the inner space to be utilized for water ballast. This vessel was designed to be operated submerged on a level keel by the use of hydroplanes; bottom wheels were provided to enable the vessel to be navigated on the water bed itself; air locks were called for to enable the crew to escape in case of danger. Holland secured the Government award because of his previous experience. His vessel, the "Plunger," was not a success, due to her enormous steam installation, which made the interior of the boat unbearably hot, and to her lack of stability. Lake's idea of running along the bottom on wheels—an entirely new conception in the art—received its first demonstration in 1894. This craft was the germ from which later emerged his "Argonaut" (1896-1897), the first submarine to be fitted with an internal combustion engine.

### 1895–1905

This is the decade of the airplane and the airship and of wireless telegraphy, all of which are described elsewhere in this issue.

A vertical turret lathe appeared in 1901. This was the invention of E. P. Bullard. The Bilgram gear-cutting machine was improved in 1898 by J. E. Gleason. The most important development in the field of machine tools was the invention of high-speed steels by Frederick W. Taylor and his associates which made possible heavier cuts and higher cutting speeds.

In 1897 Hans Goldschmidt of Essen invented the well-known thermit process. Thermit, however, was not introduced commercially until 1899. The modern process of autogenous welding was introduced in 1905 by Fouché, oxygen and acetylene being used in a specially constructed blowpipe.

An attempt to reduce nitrogen from the air electrically was made in Niagara Falls by Bradley and Lovejoy in 1900. This experiment, while not commercially successful, at least served to inspire later work. Thus Christian A. Birkeland and Samuel Eyde built their Norwegian plant in 1903, using electric arcs spread out by magnets so as to obtain a great heating surface.

The steam turbine was markedly developed during this period. C. G. Curtis invented in 1896 his multi-stage pressure turbine. A. Rateau in 1898 constructed his multi-stage pressure turbine. Zoelly in 1902 constructed a multi-stage pressure turbine which is essentially similar in principle to that of Rateau. A. Rateau invented the first turbo-compressor in 1900 and a turbo-pump in 1902.

The principle of utilizing internal work in liquefying air as well as the counter-current principle of refrigeration was discovered in 1898 by Karl P. G. Linde. The outgoing air was used to cool off the air still contained within the apparatus so as to produce a cumulative refrigerative effect. He built a refrigerating machine on this principle with which very low temperatures were reached.

In 1898 Ochelhäuser of Dessau installed an engine in the Hörde Iron Works for the utilization of blast furnace gases; the engine itself was patented in 1896, and was a two-cycle double piston engine. The Körting blast furnace gas engine was brought out in 1898. Cockerill of Seraing, Belgium, introduced a four-cycle blast furnace gas engine in 1899. From this the two-cylinder blast furnace gas engine of the Nürnberger Maschinenbau Aktiengesellschaft was shortly evolved.

In 1904 James A. Gailey brought out his dry blast process for the production of iron and steel. He solved the problem of drying the air by freezing out the water.

The American iron industry suffered a great change in this decade. The Mesaba ores were being introduced. Since the blast furnaces were far removed from the Lake Superior beds cheap handling was an essential, a consideration met by Brown's bridge cranes, cableways, and trolleys. A radical departure was made in ore handling when G. H. Hulett in 1898 invented the automatic ore unloader bearing his name.

In 1897 Karl Engler made exhaustive researches on the decomposition of hydrocarbons when subjected to heat and pressure. Thanks to him much light was shed upon chemical reactions, which take place when oil is cracked. Most cracking processes are based upon the methods disclosed in patents taken out in 1890 by Dewar and Redwood. The Dewar and Redwood process is in turn an outgrowth of the Krey high-pressure distillation process of 1887.

The method of hydrogenating soft fats and oils, whereby it is possible to convert vegetable oils into substitutes of lard and some fats into hard fats of greater commercial value was discovered in 1902 by P. Sabatier and J. B. Senderens.

The separation of ores by oils was introduced in 1902 by W. Elmore. The ground ore mixed with the residue of petroleum distillation was placed in rotating cylinders so that oil and pyrites are intimately mixed. The oil was then centrifugally separated.

In 1899 William Draper constructed a loom with automatic shuttle-changing mechanism, the first practical success of its type, and the result of ten years' experimenting. The present type of automatic bobbin-changing loom was the outgrowth of an invention made by James H. Northrop, who conceived the idea of changing the bobbin in the shuttle automatically while the loom was in motion. On June 23rd, 1891, Rhoades received a patent for shuttle-changing mechanism, which applied the principle of the weft fork for detection of the absence or the failure of filling and of an ejector to the changing of a shuttle in which the filling was exhausted. An early patent for automatic weft-replenishing looms, especially adapted for multi-colored weaving, was granted to Wyman and Crompton in 1898.

After Campbell, Tucker and Crowell had brought the newspaper printing press to a point where 24,000 to 29,000 copies could be printed an hour, no marked improvement was made until Henry Wise Wood introduced radically new ideas. Instead of drawing the paper through the press—a proceeding which subjected it to strain and reduced the speed of printing for fear of breakage, Wood carried it along bodily without strain to the printing types. The machine adjusts itself automatically to the peculiarities of the various paper rolls, so that breakages are avoided and the amount of attention required by the press is reduced to a minimum. The paper is handled in streams and assembled in a single stream made up of as many thicknesses as the newspaper to be printed has leaves. This combined stream is then folded, cut and delivered at the rate of 60,000 an hour (eighteen to thirty-two pages).

Copyright, Cincinnati Planer Co.

**One of the first planers built in this country by Ira and Ziba Gay**

### 1905–1915

In 1900 stereotyping was revolutionized by the introduction of Henry Wise Wood's "Autoplate" machine. This consists of a casting mechanism and a series of finishing mechanisms which automatically coöperate in one machine to make casts and finish them. When used to make plates of the conventional half-inch thickness its speed is four finished plates a minute; but when the thickness is but one quarter of an inch eight plates a minute are easily obtained.

In the field of machine tools the decade is marked by important improvements in gear cutting machines of the generating type. J. E. Gleason obtained patents in 1907 and 1910 and E. R. Fellows in 1907, 1908, 1911 and 1912.

One of the notable developments of the decade was the use of the gyroscope in a great many widely different applications. Mr. Louis Brennan, inventor of the Brennan torpedo, devised a gyroscopic monorail. This renewed interest in the previous invention of Schlick, who used a gyroscope to keep a ship from rocking. Dr. H. Anschütz-Kämpfe developed a gyroscopic compass to displace the magnetic compass, and this has been used with considerable success in warships, particu-

larly submarines in which the compass is entirely surrounded by a steel shell that acts as a shield for the magnetic needle and prevents it from being affected by the earth's magnetism. A gyroscopic stabilizer for airplanes was developed by Sperry in this country.

A process of dry galvanizing or "sherardizing" was discovered by Mr. Sherard Cowper-Coles. By this process iron and zinc can be coated with metallic zinc by the simple operation of bedding the piece in zinc dust in a drum and raising the temperature of the zinc dust to 500 or 600 deg. Fahr., which is some 100 degrees below the melting point of zinc. Dr. Schoop of Zürich invented a method of coating objects with metal in which the metal in pulverized state was projected against the object by a jet of high-pressure steam.

In 1907 E. G. Acheson discovered a method of producing deflocculated graphite.

Mr. H. A. Humphrey, a well-known English engineer, invented an internal combustion water pump.

Mr. David Roberts invented the caterpillar tractor which could haul heavy guns or other trailers over rough country.

The decade was particularly marked for developments in illumination, but this subject is fully covered in the special article on electricity.

Early in the decade Parsons of turbine fame brought out his "auxetophone," a device for augmenting talking machine sound reproduction by the use of compressed air, the air being admitted through a valve controlled by the needle, and hence taking the place of the reproducing diaphragm.

Fournier d'Albe invented an apparatus known as the "optophone," which renders light audible.

The closing year of the decade led to much activity in the development of war inventions. The Lewis machine gun invented by Colonel I. N. Lewis of the United States Army was widely used by the British and Belgians. This one-man gun uses part of the gases produced by the firing of the cartridge to furnish the power required to actuate the mechanism and the gun is cooled by air set in motion by the bullet. In 1915, gas warfare was introduced by the Germans.

### 1915–1920

As we come down to the present day it is increasingly difficult to pick out important inventions. Machines and processes that look very promising may turn out to be failures and an obscure invention that might easily be overlooked today may prove to be of epochal importance.

Most of the prominent developments of this period have to do with the war and their value was immediately tested. They are of such recent occurrence and so fresh in the minds of our readers that we need merely list them:

The Browning machine gun and Browning shoulder rifle were developed by John M. Browning after our entry into the war. There were important improvements in large guns, most notable of which was the German 75-mile gun with which Paris was shelled. Trench warfare led to the invention of various types of trench mortars. Gas warfare was highly developed and all manner of poisonous and suffocating gases were discovered and fired in shells by the opposing armies. Battles were carried on at night under the light of flares and star shells. The most notable invention on land was the tank, a development of the caterpillar tractor which was a factor in overcoming machine gun nests.

On the sea the submarine was highly improved. The Germans built a number of mine-laying submarines. To overcome the submarine the depth bomb was invented and the hydrophone was developed by which the presence of a submarine could be detected by sound.

Since the war a very promising development in thermo-dynamics is the Still engine. In this engine the piston is driven in one direction by internal combustion of fuel and in the other direction by steam generated by the combustion in the cylinder. The efficiency of this engine rises as high as 41 per cent, while the highest efficiency of any other prime mover is only 36 per cent, this figure having been attained by a Diesel engine. The inventor is William Joseph Still.

The most remarkable machine of this period is the type reading optophone—an instrument by which the blind can read ordinary print. The inventor is Dr. E. E. Fournier d'Albe. A complete description of this instrument is to be found in the current issue of the SCIENTIFIC AMERICAN MONTHLY.

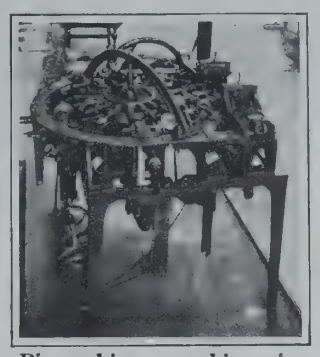
## The Current Issue of the Scientific American Monthly

ON account of the critical paper situation, the SCIENTIFIC AMERICAN MONTHLY was obliged to suspend publication for the months of August and September. Publication, however, is resumed with the October issue and we hope that there will be no further interruptions. The contents of the October number are exceptionally interesting.

One of the most marvelous instruments of the present day is an electrical reader by which the blind are enabled to read any ordinary printed matter. The "type-reading optophone," as it is called, is the invention of Dr. E. E. Fournier d'Albe. The inventor's own description of the machine is given in the current MONTHLY with photographs and diagrams illustrating the operation of the apparatus.

"The World's Supply of Energy" is the title of an exceedingly interesting paper by Dr. Svante Arrhenius, Ph.D., M.D., D.Sc., LL.D., who discusses the problem that we shall have to face when our supplies of coal and oil are exhausted. In this connection, another article entitled "Setting the Tides to Work" will be found of interest.

Dr. Caroline Rumbold, pathologist of the Bureau of Plant Industry, U. S. Department of Agriculture, tells of a new method of giving medicine to trees and shows how the chestnut blight is being fought by injections of curative chemical solutions.



**Pin-making machine invented by John Ireland Howe in 1835**

If America is to hold its place in the commercial world, we must pay more attention than we have in the past to geographic training. This subject is discussed by J. Paul Goode, Professor of Geography in the University of Chicago.

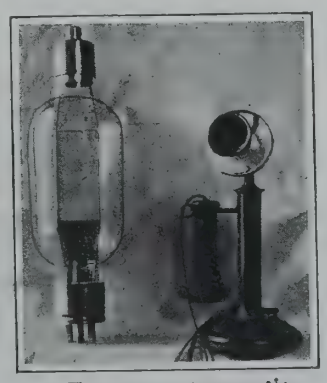
A very important article is one entitled "The Breaking Up of Nitrogen" by Dr. E. Regner, in which he shows how the theory of the transmutation of metals is verified in a startling manner by modern research.

In the March issue of the SCIENTIFIC AMERICAN MONTHLY, there was an account of an ultra rapid cinematograph which would take pictures at the rate of 20,000 to 50,000 photographs per second. In the current issue of the MONTHLY, further information on this subject is given, with actual photographs of the flight of revolver bullets, birdshot from a shotgun and a 37 mm. shell.

Dr. K. Seibel writes on the interference of X-rays, in which the vibratory nature of Roentgen rays is proved by an ingenious experiment.

There is an interesting article on the miniature textile mill of the U. S. Bureau of Standards by Herbert T. Wade.

Altogether there are twenty-six articles in the current MONTHLY, together with a large number of notes and the usual departments of the National Research Council, the Bureau of Standards, Progress in Mechanical Engineering, Mining and Metallurgy, Electricity, Chemistry and General Science.



**DeForest transmitter vacuum tube alongside a telephone to show relative size**

## Asbestos in America

AN asbestos claim has been located in Apache County, Arizona, according to an authoritaive investigation by the U. S. Bureau of Mines. The deposit, seemingly extensive in its reach, has been traced for more than 20 miles. Vein exposures are so pronounced that the passerby, in the absence of miner's tools, can pick from the wayside a ton or more of the crude product, broken down from the prominent veins.

A specimen of the deposits examined by government scientists revealed characteristics of the typical Arizona asbestos. The material is strong, flexible, silky and found in cross-fiber veins with a grain length of one to one and one-quarter inches, while fiber two and one-half inches in length has been reported. Specimens examined evidence effects of surface weathering, a better quality of asbestos doubtless being obtainable by development work.

Considering the shortage of crude asbestos in this country, it is regrettable that the Government forbids the mining of asbestos deposits on unallotted Indian lands, where this discovery has been made. The Office of Indian Affairs has recommended to Congress the lifting of the ban which now prohibits the development of unallotted Indian lands for the purpose of mining asbestos, coal, oil and gas.

The U. S. Bureau of Mines is in receipt of information from Genoa, Italy, of the manufacture of a new asbestos product. The fresh undertaking is the making of asbestos pipes of 85 per cent Portland cement and 15 per cent asbestos fiber of shingle stock grade. The pipe is constructed in varying sizes, from 4 to 12 inches in diameter and in lengths up to 12 feet. The thickness increases with the size from one-half inch for the 4-inch pipe to 15/16 for the 12-inch size.

Four machines are in operation by this foreign enterprise, each unit having a capacity of 3,000 feet of pipe every 24 hours. The finished product is seasoned under water for 90 days before used. Lighter in weight than iron pipe, among the virtues claimed for the new asbestos product is that it will stand up under a maximum pressure of 450 pounds to the square inch. It is acid-and-corrosive-proof.

Taking into consideration the excessively high cost of Portland cement in Italy, due to the soaring prices of coal, it is claimed that the expense of manufacture is not more than one-third of the net selling price of coal. The same Italian enterprise is likewise making wall tile of similar composition to the asbestos pipe. It is decorated with imitation rock surface patterns and figured designs. Although a better glaze is desirable, the material is attractive, less brittle than porcelain tile, and because of the comparatively cheap cost of production offers an inviting field for development. Owners of the Italian patent desire to grant manufacturing rights for these products to an American firm on a royalty basis. Samples of the tile are on public exhibition at the Bureau of Mines, Washington, D. C.—By *S. R. Winters.*

## A New Process to Improve Steel Making

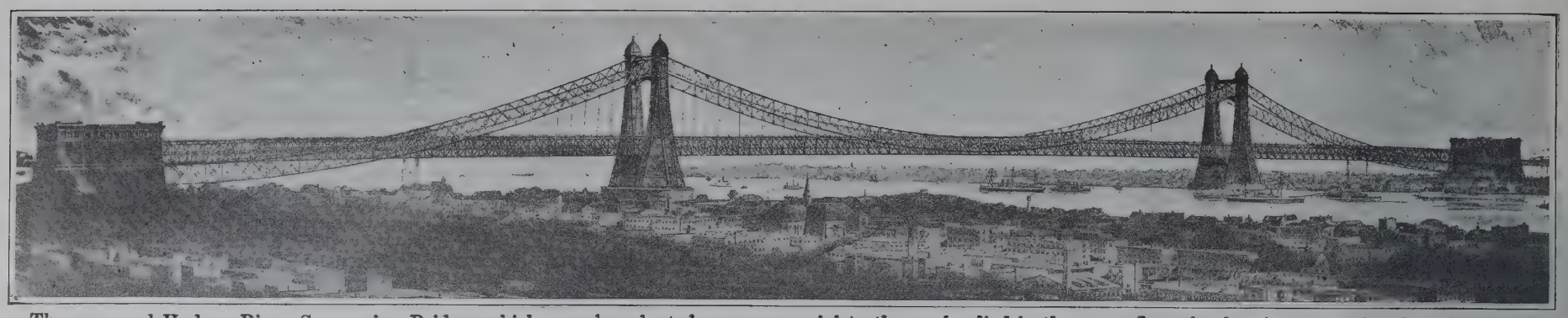
AN improvement of the acid Bessemer steel process which aims to reduce the cost of making steel and to decrease the possibility of low quality steel in the process has been recently invented by a member of the department of mining and metallurgy at the University of Wisconsin.

The purpose of the invention is to use basic material for the lining of the Bessemer converter instead of the acid lining now used in order to prevent corrosion of the interior of the converter and to reduce the amount of air pressure and engine power now required. With the basic lining, composed of lime, magnesite, dolomite, oxid of iron, or the like the inventor believes it will be possible to use lower pressure and cut down the time of blowing about 30 per cent.

To prevent corrosion of the converter bottom the inventor proposes a number of different kinds of linings for various acid Bessemer converts and details the particular parts of the converter that require such a basic lining, while the remainder of the converter has an acid lining to resist corrosion by the acid slag. The invention is applicable to the bottom-blown type, side-blown type and other kinds of Bessemer converters operating on the principle of making steel by blowing air through a body of molten iron.

## Quake-Proof Houses

EARTHQUAKES in Italy, America, and elsewhere, the great explosion at Silvertown, the alarming subsidences due to brine-pumping at Northwich, and various cases of settlement in unstable soils have sufficiently demonstrated the advantages of the "single-unit" action of the reinforced concrete skeleton system, says a British writer. Now that so much energy is being expended on the design and construction of dwelling-houses, and innumerable schemes are being submitted for approval by enthusiastic patentees, it is well that people about to build on clay soil, especially when the surface is hilly or undulating, should take into consideration the advisability of adopting the reinforced concrete skeleton as a safeguard against future troubles in the form of cracked walls, bay windows, porches and ceilings, constantly recurring damage to plaster cornices and wall paper, and frequent attention to the fit of doors in openings which vary in dimensions with the state of the weather. This is by no means a fancy picture, but fairly represents the effects of clay soil on houses of ordinary construction, the extent of the trouble naturally varying with local conditions. The monolithic reinforced concrete skeleton is a certain preventive of structural dislocations, and if the panels are fitted with brick curtain walls the building will possess all the advantages of one constructed in the ordinary way, without its shortcomings in respect of stability.



**The proposed Hudson River Suspension Bridge, which may be adopted as a memorial to those who died in the war. Length of main span, 3,000 feet; height of towers, 650 feet; width of floor, 200 feet. Capacity: 16 tracks, an 80-foot automobile roadway, and foot passenger promenades**

# Civil Engineering

## What the Man with the Transit and Level Has Done During the Past Seventy-five Years

IF we were called upon to name the technical profession which more than any other has been concerned with our modern industrial development, it would be safe to name that of civil engineering. For without the man with the transept and the level, it would have been impossible to weave over the continent of the earth its vast network of railways with its crossings of the rivers by bridge or tunnel, its vast retaining walls and embankments and its bold piercing of mountain summits by tunnels. This is said with no disparagement of the mechanical engineer, without whose multiplied activities the work of the civil engineer would have been greatly delayed and even in some cases indefinitely postponed, for his ingenious constructions have been always forthcoming to make possible the work which the civil engineer put through.

**Manhattan Suspension Bridge across the East River. Length of main span, 1,470 ft., width of floor, 120 ft. Capacity: four two-track electric railways; a 35-foot roadway, and two 10-foot sidewalks**

In a brief review of civil engineering during the past seventy-five years. we can do no more than touch lightly on the greater works which have been accomplished, and we shall confine ourselves in this review to the construction of long-span bridges, sub-aqueous tunnels, subways, canals, water supply and irrigation.

### Bridge Engineering

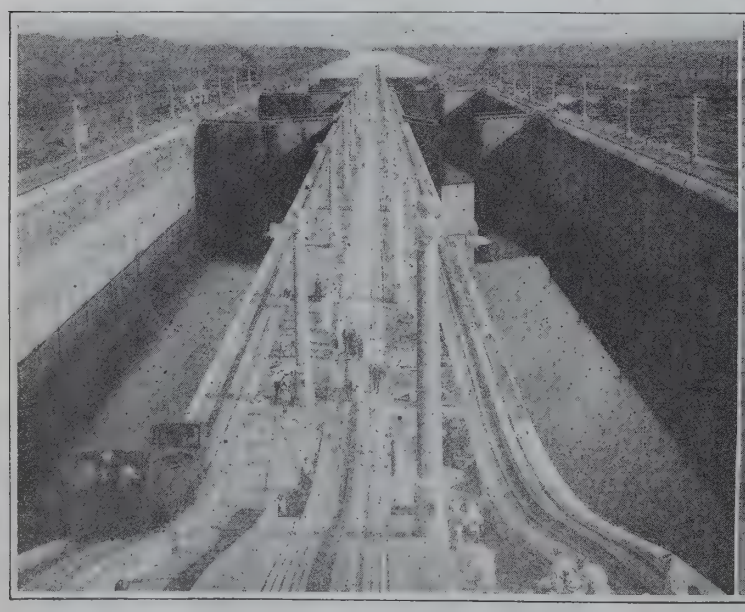
The early development of American bridge engineering shows a wide divergence from that in Europe. When we passed from the wooden bridge to the steel bridge, the eye-bar type of construction quickly beeted construction. Their bridges were more shallow and more rigid, took more time for construction and erection and were more costly. When we came to build in the larger sizes, we turned increasingly to riveted work, with the result that the modern American bridge is a combination of the two systems.

Among early notable bridges, mention should be made of Robert Stephenson's railway bridge over the Menai Straits, the crossing being made up of 8 rectangular plate-iron tubes of which four are 230 feet and four 472 feet in length. Of the same type was the celebrated Victoria Bridge across the St. Lawrence River, of 25 spans, each 244 feet in length.

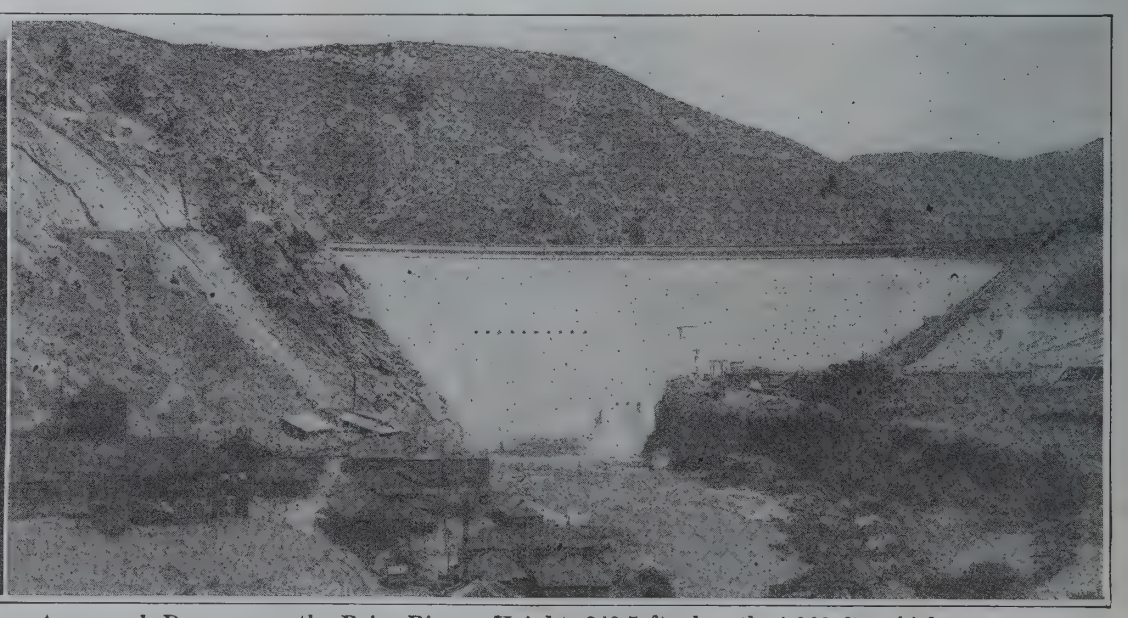
It is in the construction of long-span suspension bridges that American engineers have won perhaps their greatest distinction. In the year 1855 Roebling built the Niagara suspension bridge of 821 feet span; and in 1874 commenced construction across the East River, New York, of the beautiful Brooklyn suspension bridge, with a main river span of 1,595 feet, which will forever be associated with his name. It is carried upon four 15-inch wire cables, and the work was opened in 1883. In all the world there was nothing approaching this structure in size at the time it was built. In 1902 the Williamsburg suspension bridge over the East river was opened. The central span of the bridge is 1,600 feet. A few years later the Manhattan Bridge with a main span of 1,470 feet and a floor width of 120 feet was put in service. The steel wire cables of this bridge are 20 inches in diameter. It carries, in addition to a main roadway and passenger walks, eight railroad tracks which are laid upon two decks.

After thirty years of waiting for a bridge to cross the North River, it now seems likely that work will be started shortly upon the great railway and vehicle bridge planned by Gustave Lindenthal, and that this structure, by means of suitable sculpture and bronze tablets, will be constituted a memorial to those

(*Continued on page 350*)



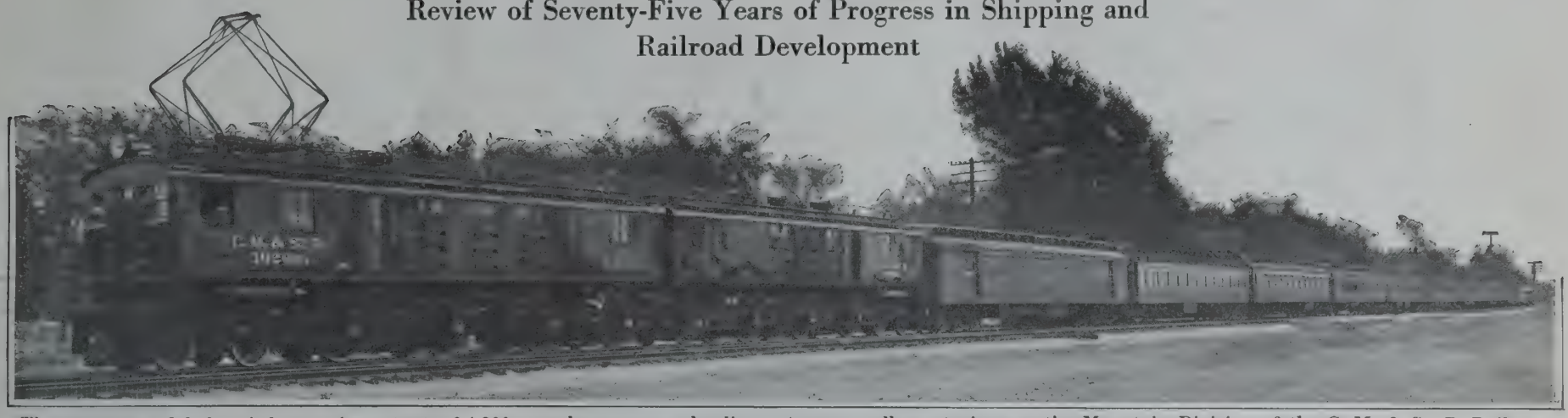
**The twin locks, in three flights, at Gatun, Panama Canal**



**Arrowrock Dam across the Boise River. Height, 348.5 ft.; length, 1,060 ft. thickness at base, 240 ft. Capacity, 244,000 acre feet**

# Transportation by Sea and Land

## Review of Seventy-Five Years of Progress in Shipping and Railroad Development



The most powerful electric locomotive extant, of 4,200 max. horse-power, hauling a ten-car pullman train over the Mountain Division of the C. M. & St. P. Railway

THERE is a sense in which it may be said that the story of human progress is the history of man's struggle to overcome the inertia of things. This is true in the domain of intellect and morals, and it is doubly true of the material world. Who shall set a limit upon the benefits that have come to us from the development of transportation? Can we not truly say that the material advance of civilization is to be measured by the facilities of the human race for travel? Certainly this holds good of the later centuries, particularly of the nineteenth and of the twentieth.

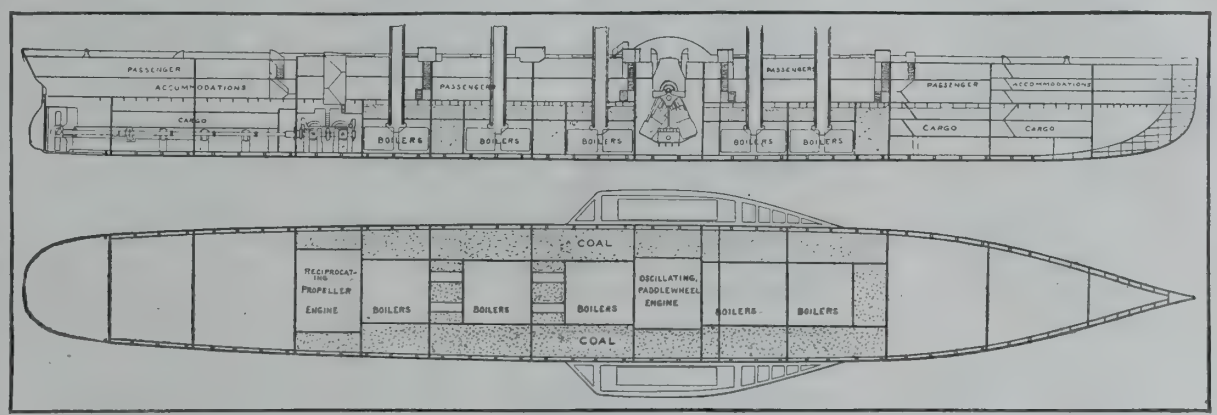
The present review of this subject is concerned with the seventy-five years covered by the unbroken publication of the SCIENTIFIC AMERICAN, and one does not proceed very far in his study of the subject before he realizes that there has been more development of transportation since 1845 than in all previous recorded history. In that early day the steam-driven ship was beginning to be a competitor of the sailing ship.

### The Beginning of Steam Navigation

Twenty-five years before the SCIENTIFIC AMERICAN commenced publication the sailing ship, "Savannah," equipped with auxiliary paddle-wheels which could be taken inboard, had crossed from Savannah, Georgia, to Liverpool in twenty-eight days, having made use of her steam power for about three and one-half days of the voyage. The "Savannah" was an attempt to apply to ocean navigation the work of Symington, whose steamboat, the "Charlotte Dundas," in 1802 had towed two 70-ton vessels successfully for twenty miles on the Forth and Clyde Canal, and the better-known work of Fulton, who in 1807 built the famous steamboat "Clermont," the forerunner of the American river steamer of today which, on its trial, ran a distance of 150 miles in thirty-two hours. Later, in 1833, the "Royal William," propelled entirely by steam power, crossed the Atlantic from Quebec. Then came the "Sirius" and the "Great Western," the latter being the first steamship designed especially for the Atlantic trade. Both of these boats reached New York on April 23d, 1838.

The voyage of the "Sirius" and the "Great Western" proved that transatlantic steamship navigation was thoroughly practical, and several lines that were destined to become famous, such as the Cunard Line, the Inman Line, the Collins, an American line, and the Anchor and the Allan Lines, began their active service.

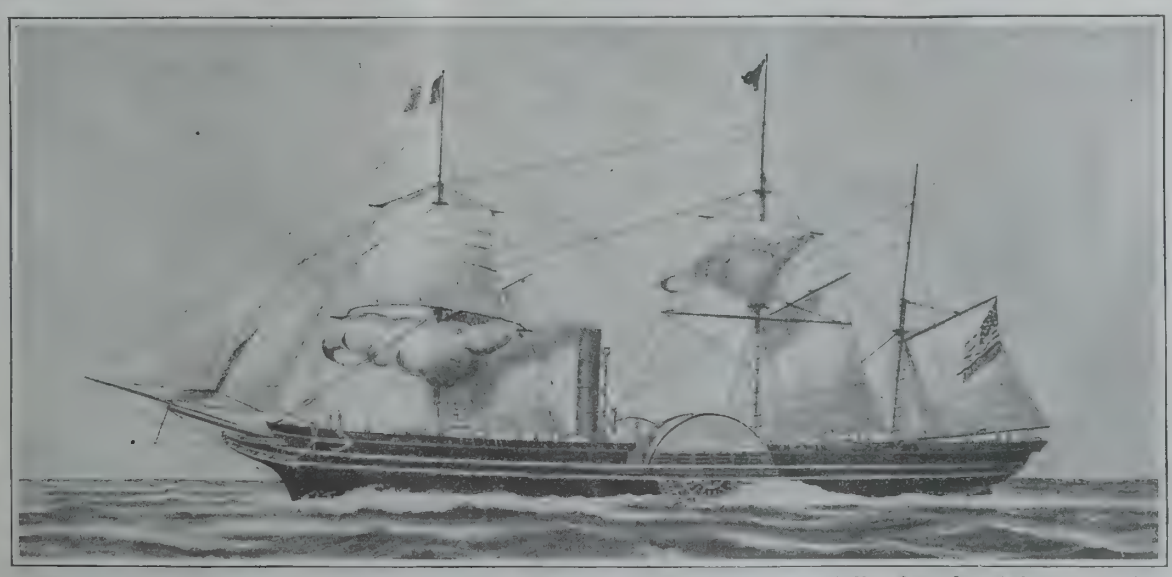
All of these early boats were equipped with side wheels and were driven by side-lever engines, which were practically a modified form of the engine developed by the great Watt. The American vessels used the overhead beam engine, and this was destined for many years to be the characteristic type both for ocean and river service. Steam pressures were very low, running from three to five pounds, and seldom exceeding ten pounds above atmospheric pressure. So bulky were the engines that they occupied nearly one-third of the length of the ship. At about the same time, experimental work was begun by Ericsson in America and by Smith and Woodcroft in England on the introduction of the screw propeller. The first British steamship to use this form of propulsion was the "Archimedes." The British admiralty, after competitive tests between the paddle-wheel and propeller, launched the "Rattler," in 1843. It was so successful that many other screw-driven naval vessels were built.




Longitudinal and horizontal sections throughout the "Great Eastern" (1858), showing the elaborate system of sub-division

Two years before the appearance of the SCIENTIFIC AMERICAN, that great engineer, Brunel, built the "Great Britain," which in size, construction and equipment marked a great advance over contemporary practice. She was 322 feet over all, and was remarkable for being built entirely of iron, with iron masts and wire rigging. Furthermore, she was divided into five, separate, thoroughly water-tight compartments.

The first American steamer to be built especially for the Atlantic trade was the "United States," of 2,000 tons. She was the first merchant steamship constructed for naval use as a cruiser, provision being made for arming her with two tiers of guns. Then came such American ships as the "Washington," of 1,700 tons, the "Hermann," of 1,800 tons, the "Franklin," of 2,400 tons, and the "Hamburg," of 2,850 tons. Conspicuous mention should be made here of the Cunard Line, whose first ship, the "Britannia," one of four built specially for the passenger and mail service, made her maiden trip from Liverpool to Boston in July, 1840. During the decade 1840-1850, the control of the steamship traffic between America and England was practically in the hands of the Cunard Company, and as a result of the inroads which they were making upon the trade of the celebrated American clippers, an American company was formed by Mr. E. K. Collins, of New York, to establish a rival line of American steamers. Four ships, which were intended by their size and speed to surpass the Cunarders, were built with all possible dispatch, and in 1850, the American company had four ships afloat which in speed and comfort were a distinct advance upon anything afloat. These ships, in the year 1851, lowered the time from New York to Liverpool to nine days, twenty hours, and fifteen minutes. The engines were of the side-lever, condensing type, and the boilers carried about seventeen pounds of steam. The best day's run of the "Arctic" was 320 knots at a speed of 14 knots. The Collins venture, opening so auspiciously, was destined to meet with a series of disasters, and these, coupled with the rivalry of the Cunard Company, who, in 1855, launched the "Persia," of fourteen knots' speed, and the withdrawal of the Government subsidy, brought about finally the dissolution of this famous company.



"United States," first American ocean-going steamship. Designed especially for the Atlantic trade

### The Famous Clipper Ship Era

Just here something should be said about the wonderful era of the American clipper ship, which lasted for a quarter of a century or, say, from 1845, when there was a demand for a more rapid delivery of tea from China, down to the opening of the Suez Canal and the coming of the large steam-driven ship. The high premium that was

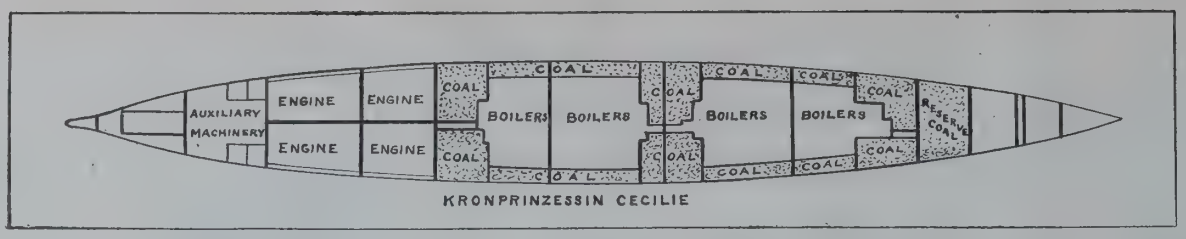
paid for the first consignments of tea led to the building of finely modeled, heavily sparred, square-rigged ships, out of which the Yankee captains got every possible knot of speed. Instead of avoiding these men courted the gales of wind, if they were favorable, and some astonishing day's runs and hourly speeds were attained. These records are authentic and anyone who loves the sea and ships will find it all written down most entertainingly in "The Clipper Ship Era," by Capt. Arthur H. Clark, one of the few survivors of that notable time. Mr. Clark copied these records from the original log books of the skippers, which he found preserved in archives of shipping companies, in museums or elsewhere.

To take one or two instances. The "Flying Cloud," during a passage of 89 days from New York to San Francisco, sailed for four consecutive days 284, 374, 334 and 264 miles—an average speed of 13½ knots. The "Sovereign of the Seas" sailed before heavy westerly gales on four successive days 396, 311, 411 and 360 miles—an average hourly speed for 1,478 miles of 15½ knots. During her great run of 411 miles in a sea day of 23 hours, 18 minutes, she averaged 17 2/3 knots. The highest recorded speed was made by "The Lightning," 244 feet in length, in 1854, during a trip from New York to Liverpool. The log entry for March 1st reads, "Wind south. Strong gales—hove log several times and found ship going through water at rate of 18 to 18½ knots; lee rail under water and rigging slack. Distance run in 24 hours, 436 miles."

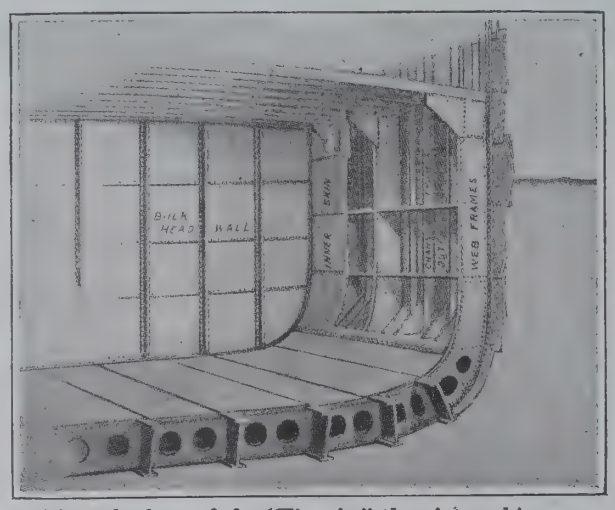
It was the delight of the skippers of those days, when they sighted a steamship ahead, to close in to within hailing distance, and sweep by the wallowing, smoking sidewheeler, while her steerage passengers jeered in derision at the "tin kettle." Twenty-five years passed before a steamship, the "Arizona," equalled the speed 18 knots achieved by the "Lightning."

### The Safest Ship Ever Built

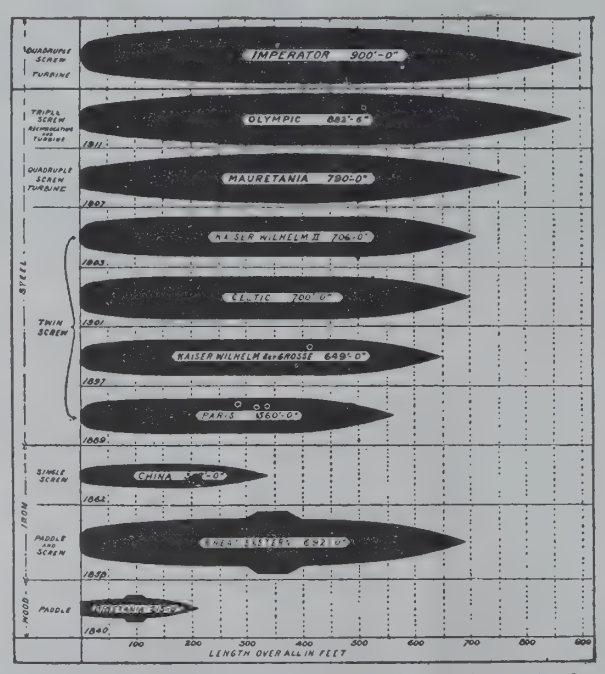
No review of the development of the steamship would be complete without mention of the "Great Eastern"—unquestionably the most remarkable ship ever constructed. In size, strength of construction and safety against foundering, and also in accommodations for the passengers, she was many decades ahead of her time. It was nearly half a century before her length of 680 feet was exceeded by the "Oceanic," of 705 feet. She was built by a company which was formed in England in 1853 to build a steamship which could carry enough coal to make the round trip to Australia and back at a speed of eighteen knots. That great engineer, Brunel, was entrusted with the design. Like "Britannia," his first iron, screw-propelled ship, the "Great Eastern," showed the inventive genius of her designer. Great attention was paid to the safety provisions. She was built with a double hull which extended ten feet above the water line and was closed in by an iron, water-tight deck. She had nine water-tight bulkheads, which were carried up to the top deck, thirty feet above the water line, and this top deck was built of iron and was double, with a space of two feet between the two decks. Longitudinal bulkheads were carried through the machinery and boiler spaces, and it is pretty safe to say that the "Great Eastern" would have survived the iceberg collision which sank the "Titanic." She was driven both by paddle wheels and propeller, a set of oscillating engines operating the former and an independent set of horizontal engines driving the propeller. She made her maiden trip from Southampton to New York in 1860, when her highest speed wos 14½ knots. The failure of the "Great Eastern" was due to the fact that sufficient passengers and freight could not be secured to make her profitable. Her best work was done in laying cables, the first Atlantic cable having been laid by this ship in 1866. In 1888 she was sold for old iron and broken up at Liverpool. The "Great Eastern" remains today the finest example of a safe ship. Gradually, in response to the demands of the steamship companies for economy of construction, the various safety devices embodied in her have been eliminated. Of the double hull, only the double bottom survives. The water-tight bulkhead deck has disappeared, and it has been lowered from thirty feet above water level in the "Great Eastern" to ten or twelve feet in most modern ships. Only in the Navy has the safety construction of the "Great Eastern" been preserved and amplified. The protection due to subdivision was proved by the ability of warships to endure terrific punishment by gun and torpedo.




**This shows the excellent sub-division of the former German steamship, "Kronprinzessin Cecilie" (now "Mount Vernon") which saved the ship when she was torpedoed during the war**




**After the loss of the "Titanic," the sister ship was improved by carrying the floor plating up the inside of the web framing so as to provide a double skin—a suggestion first made in the book, "An Unsinkable Titanic"**




**Growth of the transatlantic steamer from 1840 to 1912. Note how far the "Great Eastern" was ahead of her time. She was not exceeded until the advent of the "Oceanic" in 1899**

**The 25-knot "Lusitania." Length, 790 feet; beam, 88 feet; maximum speed, about 26 knots. This was the first of the fast, turbine, ocean liners**

The screw propeller was now rapidly driving out the paddle wheel, the "Scotia," of 3,807 tons being the last of the paddle-wheel ships built for the Cunard Line. She was the first to make the transatlantic passage in less than nine days. To the old Inman, later the American Line, is due the credit of bringing the passage below eight days with the screw steamer, "City of Brussels," of 3,747 tons. A memorable year was 1871, which saw the birth of the famous White Star Line, whose "Oceanic" and "Adriatic" introduced many features designed to increase the comfort of travel. The first ship to bring the passage below seven days was the "Alaska" of the Guion Line, and in 1889 the "City of Paris" reduced the time to less than six days. The last of the large liners to be driven by a single screw was that fine pair of ships of the Cunard Company, the "Umbria," and the "Etruria," which made their appearance in 1884. They were 525 feet in length and of 12,190 tons' displacement. Their single screw engines, the largest of their kind ever put into a steamship, indicated 14,500 horse-power, and the "Etruria" maintained a speed of 19.6 knots for the whole trip across the Atlantic.

To the Inman and International Company stands the credit for producing in the "City of New York" and "City of Paris" the first twin-screw liners, driven by triple expansion engines. These fine ships of 10,500 tons and 20,000 horse-power were a great advance upon anything built or planned in 1889, and it is notable that, together with the "St. Paul" and the "St. Louis," built by Cramp, of Philadelphia, which entered active service in 1895, these ships are still doing good work on the Atlantic route.

### Contest for Blue Ribbon of the Atlantic

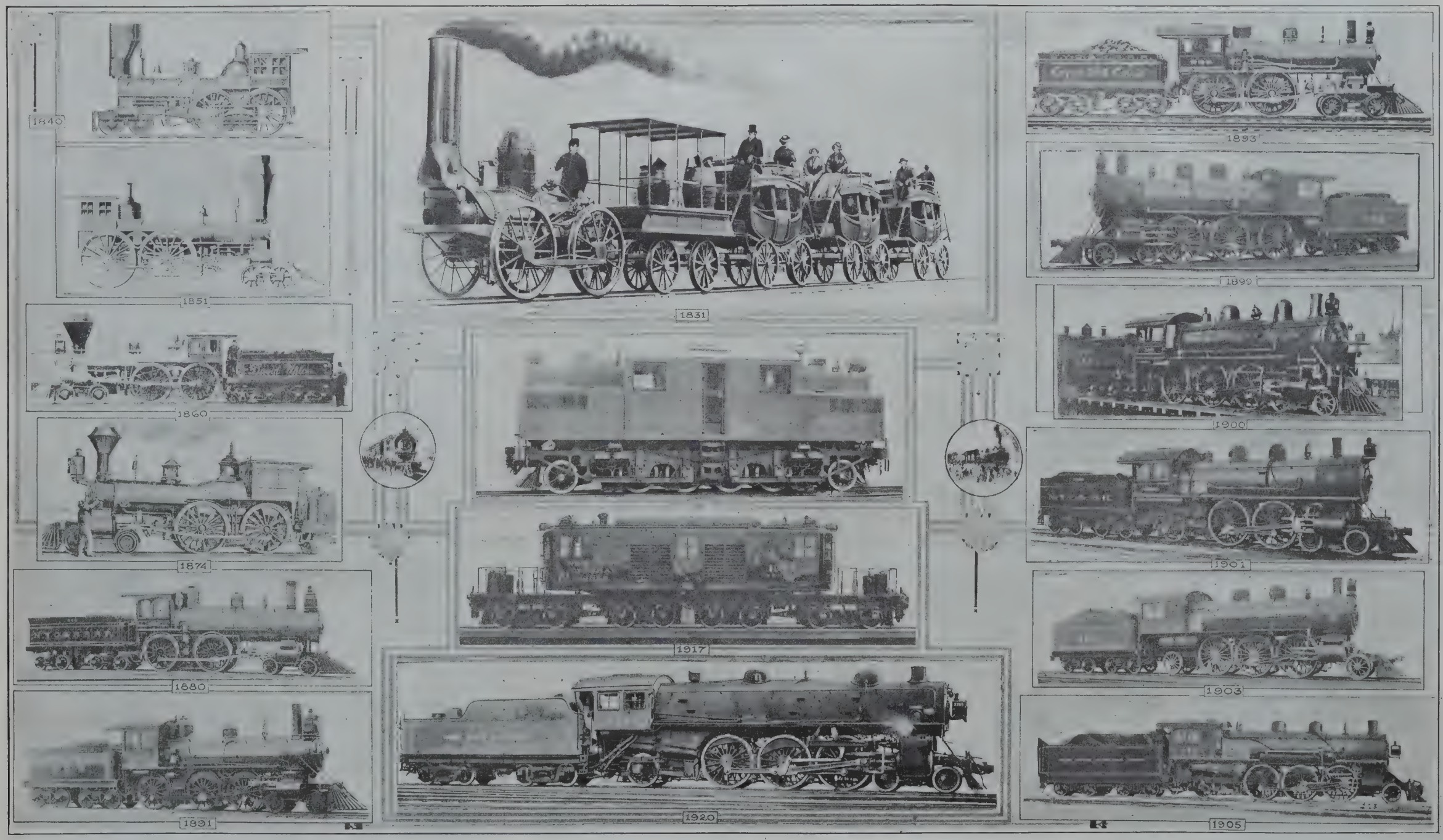
It is impossible within the limits of this article to follow in any detail the subsequent development of the transatlantic liner. The Cunard Company took the lead again in 1893 with the "Lucania" and "Campania," the first ships to exceed 600 feet in length. With 30,000 horse-power the "Lucania" crossed the Atlantic at a speed of over 22 knots.

Then, in 1897, the Germans, with the "Kaiser Wilhelm der Grosse" won the laurels. This was the first of the four-funnelled steamships of which the German companies, and later the British, were to build so many. In 1899, the White Star Company brought out the "Oceanic," 705 feet in length, the first modern ship to exceed the "Great Eastern" in length.

The Hamburg-American Line then made a bold bid for the blue ribbon of the seas with the "Deutschland," which, with 37,500 horse-power, maintained an average of 23.5 knots, thereby winning the record from the North German Lloyd, which replied by building the 707-foot "Kaiser Wilhelm II," which, with about the same speed, captured the transatlantic record.

The Germans had held the blue ribbon of the Atlantic for a whole decade when, in 1906, the Cunard Company built the "Lusitania" and the "Mauretania," 790 feet in length and of 44,500 tons deep-draft displacement. They were driven by turbines of 70,000 horse-power, operating four propellers, and they recovered the speed record from the Germans, the "Mauretania," crossing at an average speed of 26.06 knots per hour. This record was to stand for some twelve years, and in fact, still stands today, although it will probably be bettered by the "Aquitania," which has shown a great increase of speed since she was equipped with oil burners. On a recent trip to the eastward, she covered the last 129 miles to Cherbourg at the average speed of 27.40 knots; hence, it is probable that when she is shaken down, she will surpass the record made by the "Mauretania." Following the "Lusitania" and the "Mauretania," in the extraordinary growth in size of ocean liners, came the "Olympic" and "Titanic," 883 feet in length and displacing 52,000 tons. These vessels were furnished with magnificent accommodations, including gymnasiums, a swimming pool, sun parlors and all the conveniences of a modern hotel. Their speed was about 23 knots. Then followed the "Imperator," of the Hamburg-American Line with her length of something

# MILESTONES IN THE DEVELOPMENT OF THE AMERICAN PASSENGER LOCOMOTIVE




THERE were other locomotives before the "DeWitt Clinton," to be sure; but for our purposes it is well to begin with that historical train in giving a pictorial resumé of the development of the American locomotive. The "DeWitt Clinton" locomotive, built in 1831, was the second locomotive to be turned out by the West Point Foundry, and was put to work on the Mohawk and Hudson Railroad. By 1840 the American type locomotive, with four driving wheels and a four-wheeled swiveling truck, had made its appearance. The next illustration shows a locomotive of 1851 with a "cow catcher" or pilot. In the locomotive of 1860, the sandbox makes its appearance. It is interesting to note that locomotives of the Civil War period were highly ornamented, and were given names of railroad men, generals, presidents, and so on. This practice is still evident in the locomotive of 1874, which differs mainly in the matter of larger proportions for attaining still higher speeds. By 1880 the locomotive began to assume something like modern lines; indeed, locomotives of the type here shown are still in use on many of our smaller railroads and branch lines. The freight locomotive of 1891 has three sets of driving wheels, in order to insure better tractive effort for hauling the heavier trains then coming into use. In our locomotive of 1893 we have the famous "999," which broke the speed records of her day while drawing the Empire State Express. By 1899 we enter the era of large passenger locomotives, with three sets of drivers, and 1900 shows a further step in this direction. The locomotive of 1901 shows the debut of the well-known Atlantic type, with four coupled drivers, and a trailing truck under the cab. A six-coupled type of passenger locomotive is shown as the locomotive of 1903, as well as in 1905, each of these having a leading pony truck, and a trailing pony truck. On September 30th, 1906, the first electric train, drawn by the locomotive in the center of this group, left the Grand Central Station in New York City. By 1917 a still larger type of electric locomotive was introduced for hauling trains in and out of the New York terminal and for thirty miles out of the metropolis. The 1920 locomotive represents a modern Pacific type, with a leading truck, six coupled drivers, and a pair of trailers.

over 900 feet and a displacement of 54,000 tons. With 65,000 shaft horsepower she has made about 22½ to 23 knots. The next year, the fatal year of 1914, saw two other notable additions to the great Atlantic fleet in the "Vaterland," now the "Leviathan," 950 feet in length, and the "Aquitania," of 901 feet. The "Leviathan," when in good condition, can make 23 knots, and if she should be fitted as an oil burner, should make 24 knots or more. The "Aquitania" has been converted from coal to oil, with resulting additions as we have seen, to her previous speed.

### Coming of the Big Freighter

Side by side with the development of passenger travel on the high seas, there has been an even greater development of freight traffic. For many decades the passenger ships did double duty, all of them carrying more or less freight; but gradually there was evolved a special type of ship of great cargo-carrying capacity, deep and broad and of moderate engine power. In size these ships have shown a development comparable to that of the fast ocean liners, the capacity going up to 5,000, 10,000 and 20,000 tons and over, in the most modern examples. A combination of the large freight and passenger vessel is seen in the so-called "Express" ships, which by keeping down the speed to 15 to 17 knots are able to carry a large tonnage in the hold and provide comfortable and extensive passenger accommodations on one or more superstructure decks amidships.

The latest development and one that is destined to have a profound effect upon ocean transportation is the use of oil, either as fuel in place of oil in steam-driven ships, or directly in the cylinders of internal combustion motors. The latest application to the "Olympia" and the "Aquitania" has raised the speed and greatly reduced the cost of operation of these famous ships. The only limitation upon the use of the internal combustion motor is the size of the individual cylinder that can be used to advantage.

**These two photographs show what electrification has made possible at the Grand Central terminal. The tracks were lowered and roofed in, the streets restored, and fine office buildings and hotels have taken the place of the unsightly terminal tracks and yard**

## Seventy-five Years' Growth of the Steam Railroad

BECAUSE of our comparative isolation from the rest of the world, particularly during the early years of the development of our railroad system, the American railroad has marked characteristics which distinguish it as regards its track, rolling stock and general equipment, from the railroad systems of the rest of the world. These differences were due to several causes, chief among which were the comparative scarcity of our population, the great distance to be covered in those early years, the scarcity of capital and the demand for cheap and rapid construction. In Europe, with its denser population, the completion of a new railroad found passengers awaiting it on every platform and freight in every freight shed. In Europe the railroads followed the population; but in America they preceded it. Our early constructions were essentially pioneer railroads. They were built rapidly and cheaply, and were thrust out sometimes a thousand miles or more in advance of the oncoming tide of pioneer settlers. It was impossible, if the work was to be done within a reasonable time, to build our early railroads in the substantial and costly way that characterized the European work. We had to cut according to our cloth, if we may use that figure of speech, and leave the work of reconstruction to a later day when the increase of population, industry and commerce should make possible the inevitable rebuilding.

### Low Cost of the Early Railroad

In accordance with this policy, in locating a new railroad, the engineer avoided heavy cuttings and costly tunnel work; which meant that these early lines must be full of curvature and contain many heavy grades. Fortunately, the problem of bridging was simplified by the extent and number of our great forests. The Howe Truss timber bridge and the many-storied trestle carried our railroads cheaply and expeditiously across many a great river and the deep chasms and ravines of broken, mountainous country. In the days when the SCIENTIFIC AMERICAN made its first appearance, railroad track in America consisted of forty to fifty-pound rails laid on small ties, which more often than not were laid upon the graded ground without the use of any ballast. The introduction of Bessemer steel brought a stiffer, more durable and harder rail, and steel began to take the place of wood in bridge construction. As traffic grew and funds became available, the early lines were relocated and heavy mountain grades were eliminated by piercing the summit with tunnels. Heavy grades and sharp curvatures were reduced, extensive ballasting was undertaken and gradually American railroad track, at least on our leading roads, was brought up to the level of the best European practice. From the 40-pound railroad of 1845, we have gone up to the 125-pound rail of 1920; and from a single track laid upon the graded ground, our trunk lines have gone up to four-track roads bedded upon from eighteen to twenty-four inches of broken stone ballast.

How many readers of the SCIENTIFIC AMERICAN are aware that practically the whole of our railroad system, totalling some 260,000 miles, has been built during the life of this journal? For it is a fact that in 1845 there was in the whole United States only 4,633 miles of railroad, consisting of a few disconnected lines in the Atlantic and Southern States and in the Middle West. In that year the Eastern railroads were just beginning to creep across the Alleghenies into the Mississippi Valley. Taking the growth of the system by decades we find that from 1845 to 1855, our railroads grew from 4,633 miles to 18,374 miles. By 1865 the total was 35,085 miles, and ten years later, 74,096 miles. In 1885 it had risen to 128,320 miles, and by 1895 to 180,657 miles. At the opening of the present century, the 200,000-mile mark had been passed, and today the system has grown to about 260,000 miles.

### Opening of First Transcontinental Road

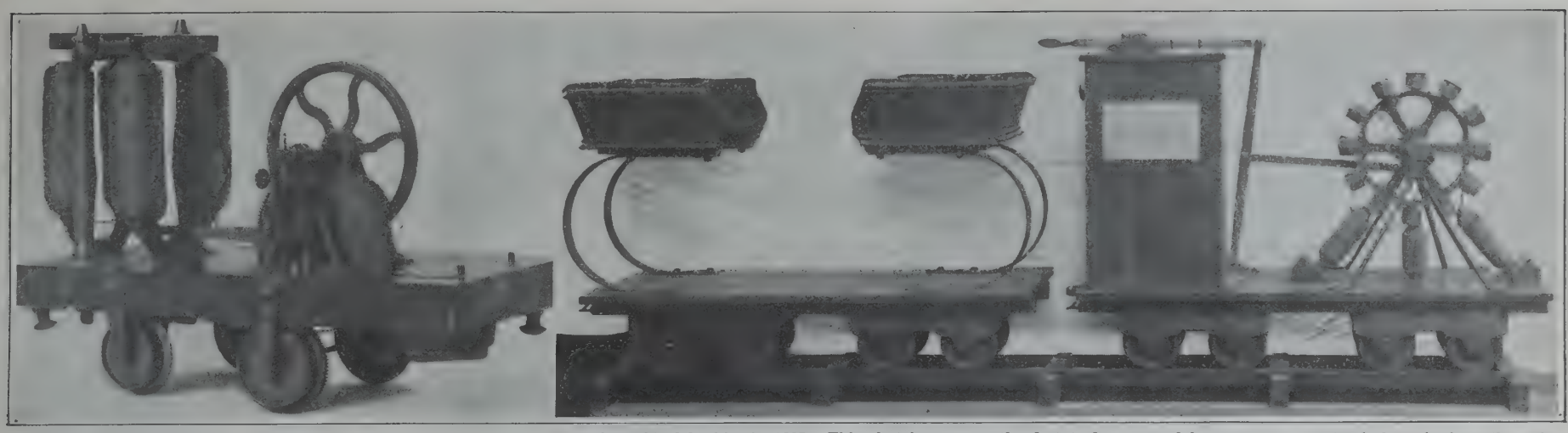
A red-letter day in the course of this progress was May 10th, 1869, when the first transcontinental road, the Union Pacific, was completed. The American passenger car, a distinctive type, with its long body mounted on swivelling trucks, was patented in 1834; and ten years later, when the SCIENTIFIC AMERICAN made its first appearance, it had come to be the typical American car. In those days it was a small and crude affair—forty to fifty feet long, lighted by oil lamps and warmed in the winter by wood-burning stoves. The improvements have been in the direction of comfort and safety. The oil lamp gave place to Pintsch gas, and steam taken from the engine replaced the dangerous wood or coal stove. The final development was the elimination of wood in favor of steel car construction, a change which has greatly reduced injuries and death due to collision and derailment. Another notable year was 1864, when Pullman brought out his first sleeper and thus led the way in a system of night travel which has become universal. Among all the inventions that have promoted speed and safety on the railroads, first place must be given to the automatic airbrake and block signal system. The airbrake, named after its designer, George Westinghouse, Junior, was first put into service in 1868-69. By this system, the engineer can set the brakes on every car and on his own engine by the manipulation of a small lever, and should the train break apart, the brakes will automatically set themselves. The automatic brake has been continuously improved, as will be seen by the following comparison. In 1890, a 280-ton train running at 60 miles an hour could not be stopped in less than 1,000 feet; but in 1915, a train weighing 950 tons and moving at 60 miles an hour, if equipped with the brake system of 1890, could be stopped in about 1,760 feet; while with the present improved electro-pneumatic Westinghouse airbrake it can be stopped in 860 feet.

### Block Signal and Automatic Stop

The greatest safeguard against railroad collision, the block signal, was developed mainly in Great Britain, where as far back as 1890, over 98 per cent of the

(*Continued on page 352*)

**"The Virginian"; most powerful steam locomotive in existence. Cylinders: 30-inch and 48-inch diam. by 32-inch stroke. Diam. of boiler, 8 ft. 7⅛ in. Total of all heating surface including superheater, 10,725 sq. feet. Tractive power: compound, 147,200 pounds; simple, 176,600 pounds**



*Left:* Electric railway motor invented and built by Dr. Gardner Colton and exhibited by him in 1837. This electric car was the first to be operated by current transmitted through the rails. The four electro-magnets served to actuate a rocking armature, which movement was transmitted by means of a gear to a pair of wheels. Adjustable contacts regulated the pull of the magnets. A flywheel aided in evening the reciprocating action of the armature. *Right:* Electric motor car and trailer built by Moses F. Farmer and exhibited by him in 1847 to demonstrate the feasibility of electric passenger carriers. The construction of his motor is quite obvious in the illustration

**Two of the pioneer electric railways from which have descended the electric street cars and electrified railways of today**

# Seventy-Five Years of Applied Electricity

## From the Telegraph of 1845 to the Radio Station of Today with a Range of Twelve Thousand Miles or More

ELECTRICITY has long been known to the scientist and experimenter, but its practical application is only of relatively recent date. Indeed, one year before the SCIENTIFIC AMERICAN was founded Morse opened his experimental telegraph line between Washington and Baltimore. That was in 1844. And telegraphy, at that time, represented the only practical application of that great and mysterious force which we call electricity.

Yet one thing is certain about applied electricity, and that is its rapid development. Following the advent of the Morse telegraph, inventors in many parts of the world set to work putting electricity to all kinds of use. In fact, the whole story of applied electricity is one of almost countless inventors in many different countries striving for the same ends; of simultaneous and identical inventions by widely separated inventors; and of developments whose origin it is difficult to trace because of the multiplicity of separate contributions entering into them. And so this story must perforce devote itself to the better known men who have done much to make electricity what it is today, without mention of many other contributors to the art whose names and achievements cannot be stated in detail for want of space.

### From Plunge Battery to Dynamo

The past seventy-five years have witnessed the development of applied electricity from the plunge battery of the laboratory bench and schoolroom demonstration to the huge turbo-generator units of today, which furnish power for driving our electric railroads, turning the wheels of our factories, lighting our homes and business places, furnishing heat for cooking a meal or for producing carborundum in the electric furnace, and so on. In fact, applied electricity would still be in its infancy were it not for the almost unbelievable strides made in the generation, control and distribution of electric energy.

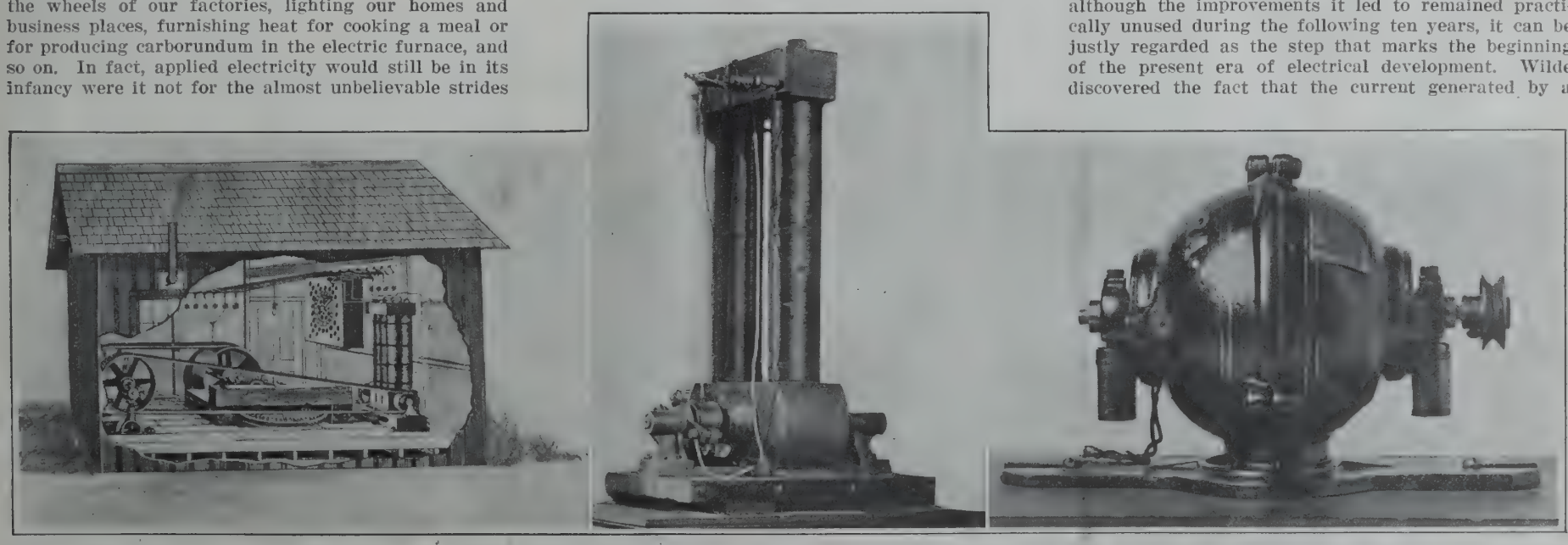
From 1850 to 1875 great advancement took place in the way of development of electric theories, and the demonstration of the laws that govern electro-magnetic actions. Since 1875 the progress has been more in the expansion of theoretical knowledge, and this is just contrary to the general impression in relation to the subject. Anyone who has doubts as to the correctness of this statement, however, can have them dispelled by a careful study of the electrical literature of the period. In the early seventies, for instance, Prof. James Clerk Maxwell brought out a masterly treatise on electricity and magnetism, in which practically every known law or principle relating to electricity and magnetism was covered.

The numerous effects of electro-magnetic action were extensively investigated at an early date, but their true relation to each other and to the other forces of nature were not properly understood until the doctrine of the conservation of energy was established upon a firm basis. Owing to this fact some of the most distinguished men of seventy-five years ago advanced views that were decidedly at variance with the facts and only served to assist charlatans in their efforts to defraud investors. So it followed that the development of the art was retarded materially until something of a very definite and authentic nature could be learned about electricity. It was this theoretical study that paved the way for the development which followed.

Soon men in various countries got to work on the problem of generating current in larger volume and at less expense than was possible with the usual battery which consumes zinc at an alarming rate for its small output. The electric motor in crude form already existed, and it was known that the motor, if made with permanent steel magnets for the field, would act as a generator of electricity if driven at a sufficiently high speed. Faraday, as far back as 1831, had demonstrated this method of developing current.

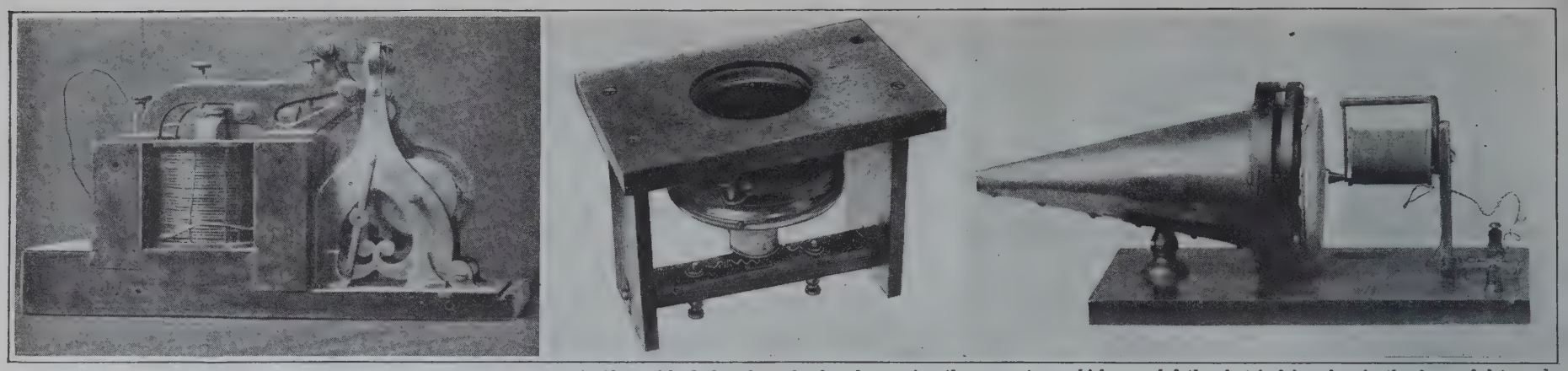
Although J. S. Woolrich constructed a generator of considerable size for the days of 1841, it was not until 1861 that anything of note was accomplished in the field of electric generation. In that year Holmes brought out a large machine of sufficient capacity to be used for arc lighting, or, more properly speaking, for furnishing current to one arc light. This machine generated current at much lower cost than the electric batteries, but its size was very great in comparison with the work it would do, and its construction was of such character as to be necessarily very expensive. Several other large machines of this type were designed and constructed during the next few years, but owing to their cost and bulkiness they did not meet with favor. The first direct current motor was built in 1860 by the Italian physicist, Antonio Pacinotti. His machine consisted broadly of an iron ring, suitably wound, which rotated between the poles of a horseshoe electro-magnet supplied with current from a battery. In the same year Pacinotti invented the commutator, which was reinvented by Gramme some years later at a time when the dynamo was waiting for just such an improvement.

In 1866 Wilde developed a machine which was the stepping-stone to the generator of the present day, and although the improvements it led to remained practically unused during the following ten years, it can be justly regarded as the step that marks the beginning of the present era of electrical development. Wilde discovered the fact that the current generated by a



*Left:* Earliest central station in United States, built for illumination purposes.. *Center:* One of Edison's early bi-polar dynamos. This type of machine gave remarkable results for the requirements of pioneer electrical days, and motors of this same type have remained in use even to this day in isolated instances. *Right:* This motor has the distinction of being the first motor to be operated by current generated at Niagara Falls and transmitted some distance over lines

**Three phases in the generation and application of electric current**



*Left:* The original Morse receiver used on the Washington-Baltimore line in 1844, with clockwork mechanism for moving the paper type which recorded the electrical impulses in the form of dots and dashes. *Center:* Bell's original Centennial iron box receiver. During the exercises inaugurating the trans-continental telephone service between New York and San Francisco, Dr. Bell used a replica of this instrument with good results. *Right:* Bell's adjustable telephone of 1876. This was a receiver, and the ear was placed at the small end of the sound horn

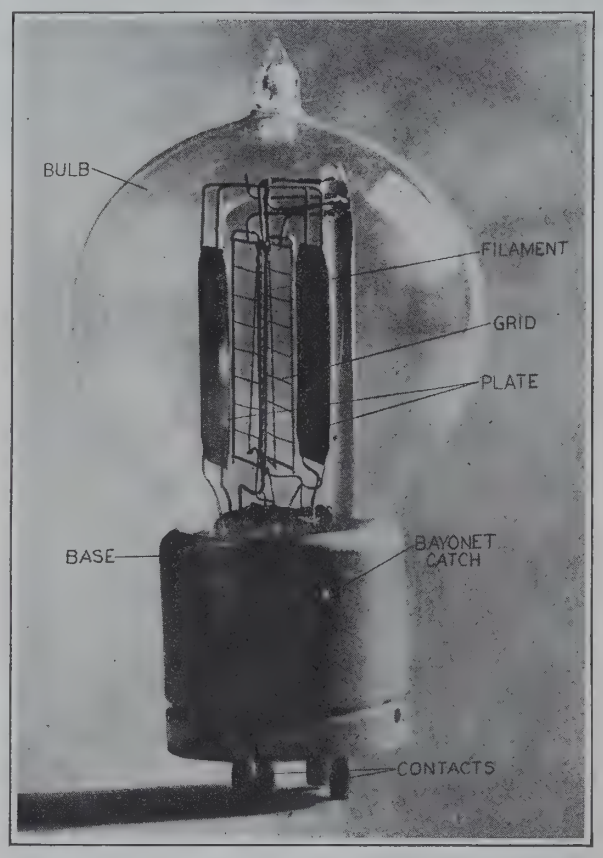
**Pioneer days of telephony and telegraphy as reflected by typical apparatus**

small magneto machine, if used to energize a powerful electro-magnet forming the field of a larger machine, would enable the latter to develop a current many times greater than that of the small machine. This discovery resulted in directing the attention of scientific men to the subject with renewed vigor. After a careful consideration of Wilde's work, the conclusion was arrived at that if a comparatively small machine could energize the field of a much larger one that would generate a current many times greater, it ought to be possible to use a part of the current of the large machine to energize its own field, and thus dispense with the smaller machine. But it was thought that the assistance of the small machine would be required to start the action. By actual trial it was found that the larger machine would start a current without assistance of the small one. And that was the basis of the present generator.

### Refinement Follows Refinement

From 1866 to 1876 very little was accomplished in the way of practical development, but quite considerable in the way of improving the dynamo or generator. In the machine of Wilde and several others that immediately followed it an armature was used that gave pulsatory current. Gramme made an improvement in this direction by adopting a ring-shaped armature upon which the wire was wound in a great many sections, the ends of which were attached to a commutator of a corresponding number of sections. The result of this construction, known as the commutator, was to produce uniform current, and the former destructive sparking of the brushes was practically eliminated. Siemens, also, worked in this line and accomplished the same results by the use of a drum-shaped armature.

From 1876 on the development of the electric generator was accelerated. Edison turned his inventive genius to the problem of the generator and current distribution at about that time. Both Edison and Weston hit on the idea of the three-wire system of current distribution, thus making electricity available over a wide area at a low cost. In 1878 Charles F. Brush introduced his famous compound dynamos, at a time when Edward Weston's dynamos were also in the market. In 1880 Gaulard and Gibbs worked out a system of distributing alternating current at high tension. They utilized induction coils, which were transformers, but which they called "secondary generators." This early transformer was one of the first steps which rendered it possible to transmit electric energy to great distances. Déri and Zipernowsky, in 1882, improved upon this work, and the term "transformer" came into being.




The action of the vacuum tube is still a matter of conjecture. Generally, its action is said to be due to the emission of a constant stream of electrons from the heated filament to the plate or plates, regulated by current on the grids

**Typical vacuum tube and its essential members**

But the modern transformer system, which involves transmission from a station of high potential and the reduction of the potential in the secondaries of transformers, was worked out in a small way at the Franklin Institute in Philadelphia in 1879, by Prof. Elihu Thomson. In fact, all the way through the development of electric generation, distribution, and application we come across the extensive and invaluable work of Prof. Thomson.

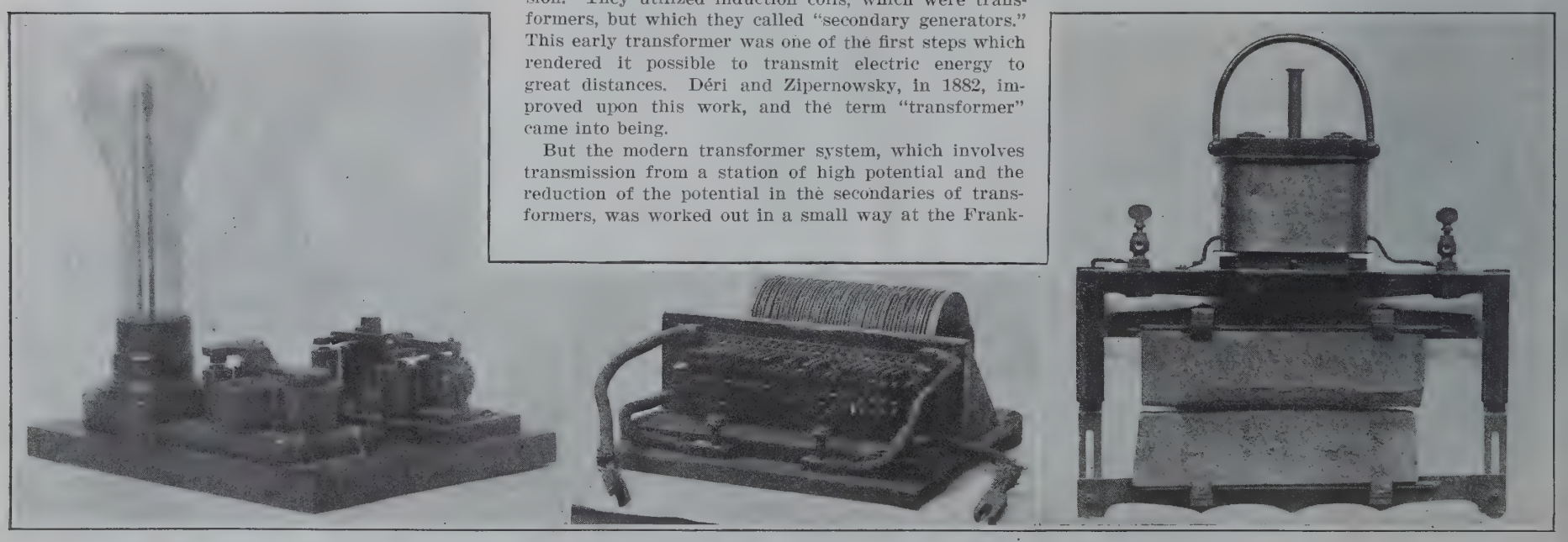
The storage battery, which plays an important rôle in power generation, began to assume practical form in 1882 when Camille Faure improved Planté's accumulator by inventing the pasted type of storage battery. Planté formed his super-oxide of lead after charging; Faure used a compound of lead oxide and lead superoxide, which he applied directly to the negative electrode.

The first alternating current central station of London was built by S. Z. de Ferranti somewhat later, and it served as a model for subsequent installations. In 1887 Nikola Tesla invented the polyphase alternating current motor which made it possible to transmit electrical energy still more economically. The first alternating current machine for generating polyphase current seems to have been built in 1888 by Hasselwander. In the same year Chas. S. Bradley patented a two-phase motor. The first installation for transmitting multi-phase alternating current at high tension was built in 1891 by von Dolivo-Dobrowolski of Berlin, between Lauffen and Frankfurt.

Refinement after refinement followed from that day to this. The introduction of the steam turbine caused the building of still larger generators than were used with the greatest of reciprocating engines. The demand for cheap electric power caused the harnessing of mountain streams and the transmission of the power many hundred miles to the consumers in the distant cities. The nickel-iron storage battery came into use, being invented by the Swedish engineer, Jungner, but perfected and placed on the market by Edison.

### The Rise of the Electric Motor

Peculiarly enough, the motor antedates the generator. Indeed, any of the electro-magnetic motors in which the current was reversed would have generated a current so strong, if they had been rotated backward, that its presence could not have escaped notice. Yet hundreds of these machines were experimented with for

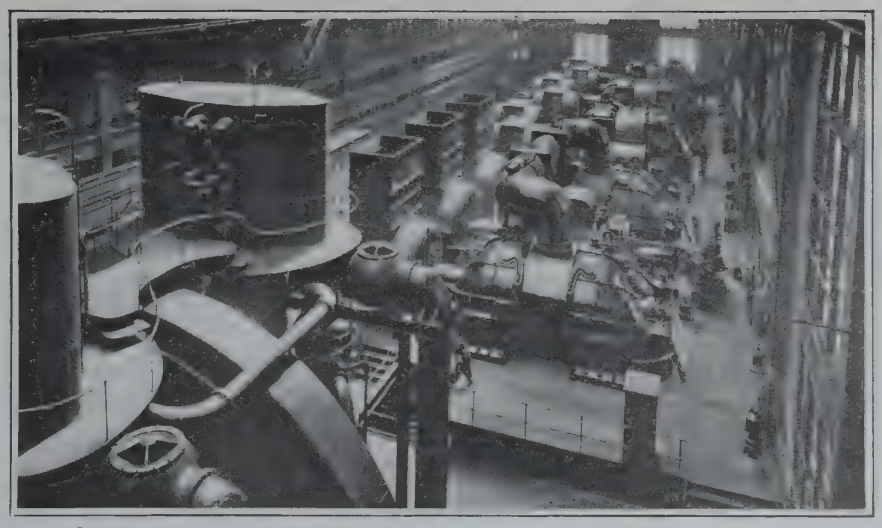


*Left:* Carbon arc type of electric lamp patented by Hiram Maxim on September 24th, 1878. *Center:* Original electric welding transformer invented by Elihu Thomson and extensively used as early as 1886. *Right:* Arc lamp invented by Wm. Wallace of Ansonia, Conn. The peculiar feature of this lamp was the use of the carbon plates 10 inches wide, between which played the arc

**Milestones in the development of the electric lamp and the process of electric welding**

more than a quarter of a century and the fact was never discovered, although all the while there was urgent need for some cheaper form of current generator than the usual zinc-consuming battery.

The development of the electric motor has followed more or less closely that of the generator; to be sure, for all practical purposes the motor and the dynamo are almost identical in general design. With the improvement in the generation of current, the motor, too, was improved, and its mechanical capacity kept pace with the electrical output of the generator. It remained for the pioneers to develop suitable systems for the economical distribution of current before the motor became a universal source of power, such as it is today. Year after year we find the electric motor growing in importance until it seems that practically every piece of machinery in the shop, store, home and elsewhere is driven by electricity, providing there is a source of current within ready reach.



**A modern power-house showing the former reciprocating engine in the foreground and the latest type of turbine units farther back**

The most startling application of the electric motor was no doubt the electric railway, beginning with the experimental attempts of Davenport in 1837. The possibilities of the electric motor in this field were seriously considered long before the electric motor made headway in other directions. In 1851 the versatile and daring Moses G. Farmer of Newport made rather unsuccessful experiments with an electric railroad, in which the current, derived from a battery, was sent through the rails. In 1851 Thomas Hall of Boston succeeded in driving a vehicle with a magnetic machine supplied from a stationary battery—an early attempt at electric automobiling. In 1854 M. Davidson also made experiments with an electric automobile. Numerous inventors tried their hand at the electric railway, which seemed to be a most difficult problem to solve despite its apparent simplicity in the light of present-day knowledge and equipment.

In 1879 Siemens constructed an experimental electric railway which actually carried passengers. Several others worked in this field in the following years, including Edison, who constructed a full-sized electric railway at Menlo Park during 1880-82. However, it was not until 1888 that complete success on a commercial scale was attained. The equipment of all the street railways of Richmond in that year, and the complete success of the installation, was the real beginning of the introduction of electricity for the operation of railways. As in the case of the dynamo and the motor, one refinement has followed another in the development of the electric railway and the electrified railway. As recently as 1901 Frank J. Sprague, the well-known American electrical engineer, invented his famous multiple unit system of control for electric railways, which has made possible the operation of electric trains in our subways and on our elevated railroads. In 1902 B. G. Lamme of the Westinghouse organization brought out the high tension motor for single phase alternating current, which was soon introduced on electric railways. And with a few more additions this brings us to the present electric railways which make their way through our city streets and spread far out in the country so as to weave suburbs and hamlets and cities into one, and to the present electrified railways which have banished the snorting, smoking and noisy steam locomotive.

### How Electric Lighting Came About

Again we must mention that enterprising person, Moses G. Farmer of Newport, who in 1859 illuminated his house with forty-two platinum incandescent lamps, thus giving us one of the earliest instances of electric lighting. But it was many years before electric illumination was systematically developed.

The arc lamp and the incandescent lamp bore more points in common in the early days than they do now. For example, the first arc lamp to be extensively commercialized was the "candle" of Jablochkoff in 1876, which gave less light than many of the modern incandescents do, and embodied a "filament" at the top, the fusion of which started the arc. On the other hand, among the earliest incandescent lamps were the so-called "incandescence-arc" lamps, based on the principle of an arc playing between two incandescent wires in a partially evacuated bulb. Again, the material in both cases was the same, carbon being used for lamp filaments and arc electrodes. Subsequent development soon caused the two forms of electric illumination to drift further and further apart, as the arc lamp continued to use carbon and metallic electrodes and the incandescent lamp turned to osmium, tantalum and tungsten.

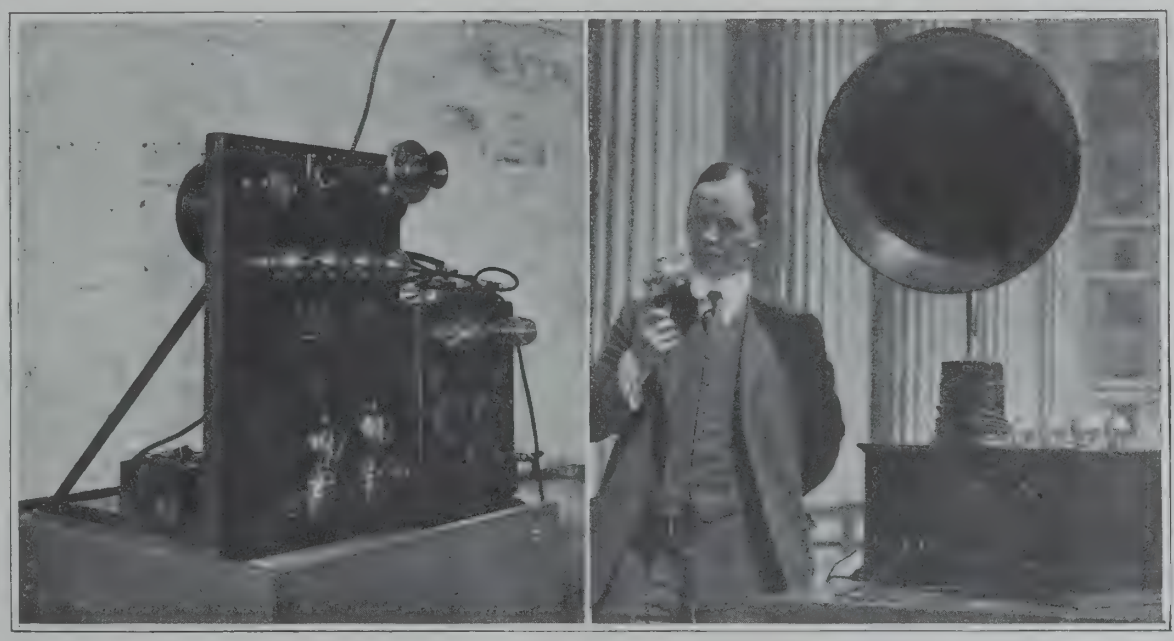
The arc lamp is a device of long standing in the art. Indeed, Sir Humphry Davy in 1801 first observed and studied the phenomenon of the electric arc. It was not publicly exhibited until 1809, when Davy, in the absence of a generator—he was too far ahead of electrical developments—made use of a mammoth battery of 2,000 primary cells at the Royal Institution, London, for his current.

We now skip several decades, during which the idea of electric illumination received much attention by experimenters and scientists, both in the form of crude attempts and in simple suggestions. Some of the suggestions and actual lamps are interesting and ingenious, but of little if any importance as far as the advancement of the illuminating art is concerned.

In 1875 the Sprengel vacuum pump, which became almost immediately an important factor in solving the problem of successful incandescent lamp manufacture, was introduced. The following year Lieut. Jablochkoff patented his famous "candle," consisting essentially of two vertical strips of carbon separated by a thin fusible insulating barrier, across the top of which an electric arc played. Europe proved quite a good market for this odd "candle," but it met with little success in the United States, where it came in direct competition with the early incandescent lamps.

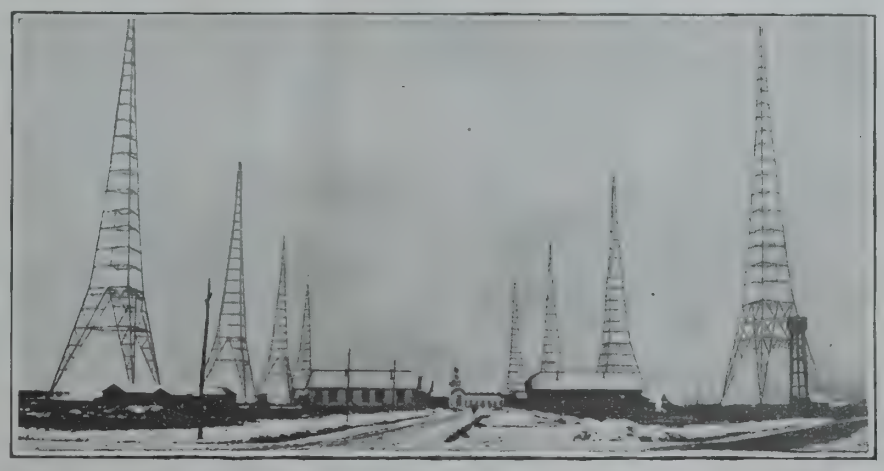
Meanwhile Charles F. Brush and Thomas A. Edison applied themselves to the stupendous and hitherto unsolved problem of utilizing electricity for general illuminating purposes. Brush exhibited his first arc lamp of the wonderfully simple and successful ring-clutch type in 1877, and in the next year introduced that other indispensable feature of his system, the series arc dynamo, and started arc lighting campaigns all over the world.

The history of the arc seems incomplete without mentioning the early work of Elihu Thomson. He invented a generator, absolutely unique. In connection with it he developed the magnetic blowout, which has been extensively employed ever since in controllers, lightning arresters, and circuit breakers. Indeed, the Thomson-Houston and Brush arc systems were active competitors.



*Right:* One of the many uses to which the vacuum tube has been put is the loud-speaking telephone. This apparatus enables a speaker to address tens of thousands of persons without raising his voice. He speaks into a mouthpiece and a bank of vacuum tube amplifiers magnify his voice many thousands of times until it thunders out of the huge horn. *Left:* A typical wireless telephone transmitter which can be attached to any standard light socket and operated on either direct or alternating current. Vacuum tubes play the leading role in this, as well as in all small and medium sized radio telephone transmitters

**Two uses for the versatile vacuum tube of today**



**The Lafayette radio station at Bordeaux, France, which has a transmitting range of 12,500 miles—virtually half way 'round the world**

### The Great Search for Filament Material

In 1879 several inventors were working on the incandescent lamp problem, among them Sawyer and Man, who experimented extensively with filaments of carbonized paper; Lane-Fox, who used vegetable fibers; Swan, who publicly exhibited a lamp with a filament of parchmentized thread; Weston, who worked even at that early date with squirted and cut nitrocellulose, and Edison, who tried out substances far too numerous to mention here, but including platinum, lamp-black, tar, and paper. There were numerous failures among those working on the incandescent lamp problem, but these did not deter other inventors and experimenters from going ahead with what seemed such a futile search for a suitable filament material.

Edison's famous exhibition of his complete incandescent lighting system, when

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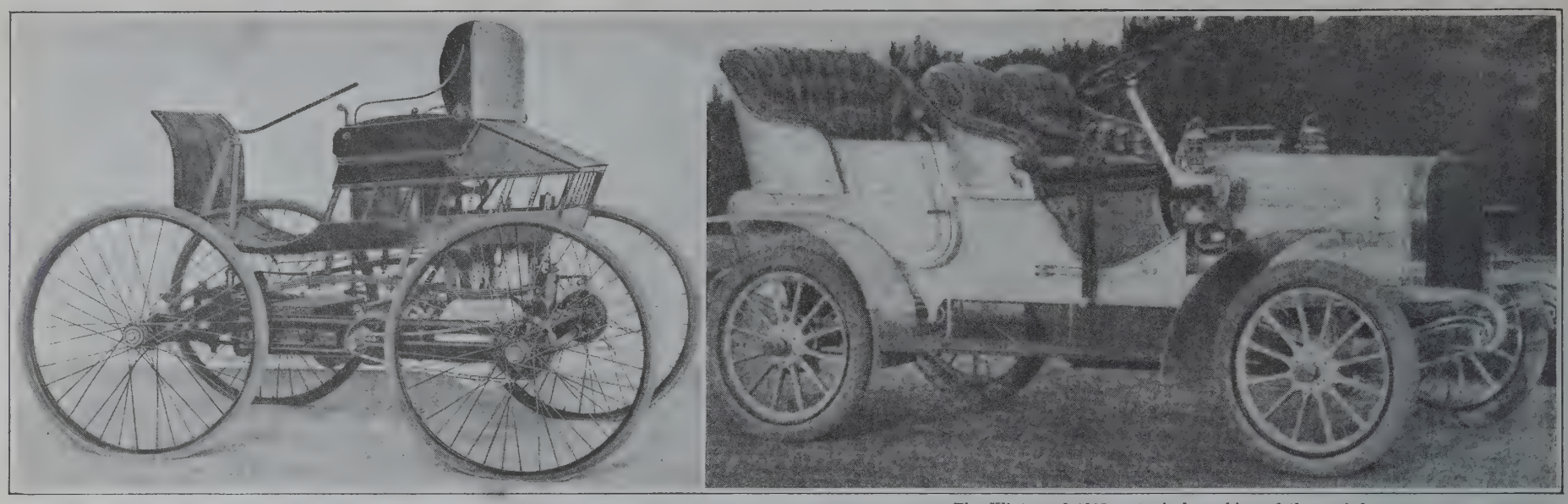


One of the earliest American models, the Duryea machine of 1894

The Winton of 1905, a typical machine of the period

**Representative designs from the age of the horseless carriage and from the transitional period in which automobile design was crystallizing into its present form**

# The Rise of the Automobile

## How One of the Props of Modern Existence Came Into Being and Acquired Its Present Position

*THE first successful four-cycle gas-engine was built in 1876. The first successful application of such an engine on a vehicle took place in 1887. The manufacture of horseless carriages for sale was first undertaken in America in 1894. The industry was first recognized in the census reports of 1899, with an output of 3,700 cars. The truck was first differentiated from the passenger car in 1904. The million mark in annual production was first passed in 1916. Today there are seven million in operation in the United States. The automobile has been developed from its inventive origin in less than fifty years. Its manufacture has been developed from nothing in less than twenty-five years. In this time it has come to be the most vital single adjunct of modern civilization. Truly we are living in a rapid era.*—THE EDITOR.

VEHICLES to propel themselves were designed long before the day of the internal-combustion engine. But the very name of road engine given to these as a class emphasizes their utter lack of true historical connection with the automobile of the present day; they represent merely isolated individual effort and are of antiquarian rather than historical interest. At the same time, we have automobiles on our roads today that run on other principles than that of the gas engine, and their proponents look more or less confidently toward their ultimate domination of the field.

But the purpose of this issue is to tell, not of all that has been or may be, but rather to show how the big things of today that did not exist 75 years ago have come into being. It seems therefore desirable to recognize that when we say "automobile" we mean the gas-driven car that dominates the field today; and, excluding the abandoned ideas of yesterday and the potentialities of tomorrow, to tell the straight story of how the machine was created that depends for its operation upon the explosion of a charge of gas within its vitals.

This story necessarily begins with the engine. The road locomotives of the decades before the 80's were so cumbersome and so generally objectionable as to make it clear in the retrospect that automotive progress waited on some new departure in the way of prime mover. With the ordinary cannon and rifle before him, the imaginative inventor of many generations realized that here was a means of power that wanted only proper control. As early as 1794 the British patent records give testimony of this realization; but the first essential of compressing the charge before firing was missing. William Barnett, in 1838, first grasped the necessity of compression; he was likewise the first to effect a moderately sensible solution of the ignition problem, designing a plug-cock that transferred a flame from outside the cylinder to inside at the critical moment, in spite of the apparently insuperable obstacle that the internal pressure was greater than the external.

The first man to attempt the explosion of the charge by means of the electric spark was E. Lenoir, in 1860; but while he manufactured several hundred engines, the ignition was not reliable. Neither did he have the proper conception of how to handle his explosive mixture. Clear ideas on this subject were first promulgated in 1862 by A. Beau de Rochas, who published a little pamphlet in which he defined clearly the intake, compression, power and exhaust strokes, and showed plainly why the cycle of these four operation was essential to the development of the internal combustion engine.

### Otto's Engine and What Came of It

The Frenchman's work was lost sight of, however, and his four-stroke cycle had to be invented independently by N. A. Otto, who embodied it on his engine of 1876. This is so distinctly the parent of the modern internal-combustion engine that Otto is recognized as the inventor of this device. But his engine was sufficiently crude, in comparison with those of today.

In the first place, it was of a single cylinder, necessitating a fly-wheel of disproportionate bulk to carry the piston over the three unproductive strokes. The explosive medium was a mixture of gas and air, effected as today, before introduction into the cylinder; it was fired by means of a metal tube heated to incandescence. This tube led into the cylinder, through a valve which opened at the proper moment. The gas flowed into the tube, ignited, and communicated the state of explosion to the main body in the cylinder. The ignition valve closed at the completion of the exhaust stroke; like intake and exhaust valves, it was operated mechanically, but by gears rather than the cams of today.

There remained much to do to the Otto engine before it could be put on an automotive vehicle. It was a heavy, slow-running affair, making from 150 to 250 revolutions per minute. The engineers of the day believed that any greater engine speed was incompatible with durability and smooth running. Gottlieb Daimler showed the error of this by producing, between 1883 and 1887, small light engines running at about 800 revolutions. Another fundamental innovation, which, while not original with Daimler was first a complete success with him, was the use of a liquid fuel. This, of course, necessitated something in the way of a carburetor to impregnate the air passing to the cylinders with the vapor from the fuel. Preceding efforts in this direction were based on a faulty principle, relying on the air to pick up enough vapor while passing over or bubbling through the liquid. Under such treatment, however, the heavier fractions do not get taken up; the liquid in the mixing chamber gets heavier and heavier, until finally it comprises nothing that the passing air can take into suspension.

Daimler invented a device which, while lacking proper response to changed speeds and loads, in its essential features anticipated the modern float-and-jet carburetor. In his light, fast engine with higher compression than before, and his easily handled liquid fuel, he had the main ideas necessary to the installation of a gasoline engine on a vehicle. He actually equipped bicycles and carriages with his engines; and on March 4th, 1887, he operated the first gasoline-propelled motor car. He well deserved this distinction, for more than any other one man he invented the automobile.

**Barney Oldfield and Henry Ford in the first car that ever traveled a mile a minute**

### Touching Off the Charge

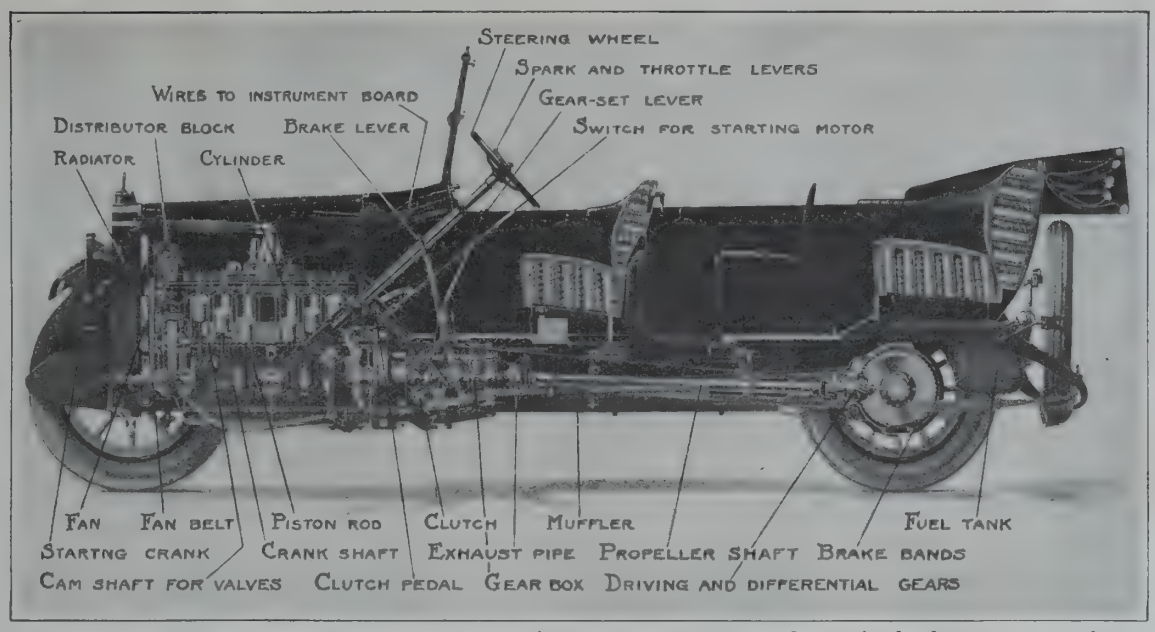
Daimler employed Otto's hot-tube ignition; but before he had it in successful operation on the road, an electric ignition device had been invented by Karl Benz. Benz fitted his engine to a tricycle, and though not exhibited until 1888, it was completely designed as early as 1885. He employed a battery for his current. But in spite of his example, the far less elegant hot-tube ignition persisted in favor among European designers, and it required fresh onslaughts from America, in the shape of the Haynes, Duryea, Olds and other models of the early 90's, to drive it from the field. Even then it hung on, with some of the European makers, until 1900 or thereabouts.

Electric ignition itself presents alternatives between dry battery, wet battery and generator as the source of current;

and between low tension with make-and-break gap, and high tension with fixed gap and jump spark. Each of the early designers worked out his own salvation in this complex business, and it is profitable to mention no names until we come to the inventions of Simms and Bosch that made the magneto the specialized and satisfactory machine that it is. The tendency at first, in turning from the hot tube, was toward dry battery and make-and-break spark; the refinements that make a magneto of the generator were not at hand, and there was hesitation about putting a wet battery on a moving vehicle. The late 90's saw the beginnings of the high-tension development which in the new century was to lead to the magneto, and at the same time found experimenters more willing to give the wet battery a chance. It was not until 1904 or 1905 that the magneto was strictly a high-tension device; and though it was gaining fast, at this date the battery, usually wet, was in the majority. When the Locomobile first appeared as a gas car, in 1903, it was far in advance of its time in carrying two wet batteries for ignition, with a dynamo for keeping them charged. Another look ahead characterized the Peerless of 1907, the first instance which the present writer has found of dual ignition with battery and magneto. On the whole, the tendency until 1910 or 1912 was distinctly away from the battery; and the magneto would doubtless have become universal, had not ignition got snarled up with another question which will be discussed presently.

The transmission of power from the gas engine is a problem wholly peculiar to that engine. For the gas engine will not start without external action; it will not start at all under load; and whatever load it is to carry must be picked up gradually. At the same time, satisfactory regulation of running speeds cannot be got solely by governing the engine, which is fundamentally a constant-speed machine; and the engine will not run backwards, so that reversing must be accomplished, if at all, by means of an extra unit in the gear assembly.

Here we have to introduce another name, with the statement that if Daimler was father of the automobile, Levassor was at least a foster-parent. This French pioneer acquired the French patents of Daimler, with the single purpose of applying them to an automotive carriage. He devised practically out of whole cloth the combination of clutch, gear-box and transmission which has stood ever since as a standard feature of automobile practice, its general features unaltered in the face of multitudinous changes in detail. At the same time he is the responsible author of the convention that puts the engine in front, with its crank-shaft parallel to the long axis of the vehicle.




**A representative 1920 car of the high-priced, high-powered variety, shown in broken-away section to exhibit some of the parts which are to be recognized as characterizing the automobile of today, as distinguished from its predecessors of the horseless carriage and the transition periods**

**The last word of 1920 in big trucks, showing use of giant pneumatic tires**

### The Engine and the Car

We would not be understood, in thus evaluating the contribution of Levassor, as minimizing the ingenious devices which others since his time have added to make the operation and especially the control of the transmission simpler and more effective. The Levassor system, as crystallized by Panhard, called for a separate lever for each speed, or at best for a gear-box permitting passage from a given speed only to the one next above or below. The Packard design of 1902 marked an epoch, introducing the selective gear-set and the single lever in the H-slot operating all gears. During the ensuing eight or ten years the sliding-gear system with four or three speeds and reverse, controlled by gear lever and clutch pedal, together with the equally standard planetary two-speed-and-reverse two-pedal-control system, were developed to their present final form. But it was not until about 1910 that the left-hand drive first assumed a dominant position, so that the rather crude expedient of placing the control levers outside the car in order to have them at the driver's right might be eliminated, at least as a characteristic of American cars.

Otto's original engine was of a single cylinder, as was Daimler's and apparently all the others of the period. But the single cylinder with the four-stroke cycle means that the crank-shaft must revolve twice for each power stroke. An effort to avoid this by means of a two-stroke cycle appeared for a time destined to succeed. At least one of the American pioneers—Elwood Haynes—started with it; but largely by sheer accident, it was shelved in favor of the four-stroke cycle with multiplication of cylinders, which became universal. It was not at first apparent that this would go beyond the point of two cylinders, or at the very most four. In 1902, for instance, the Packard and the Knox were

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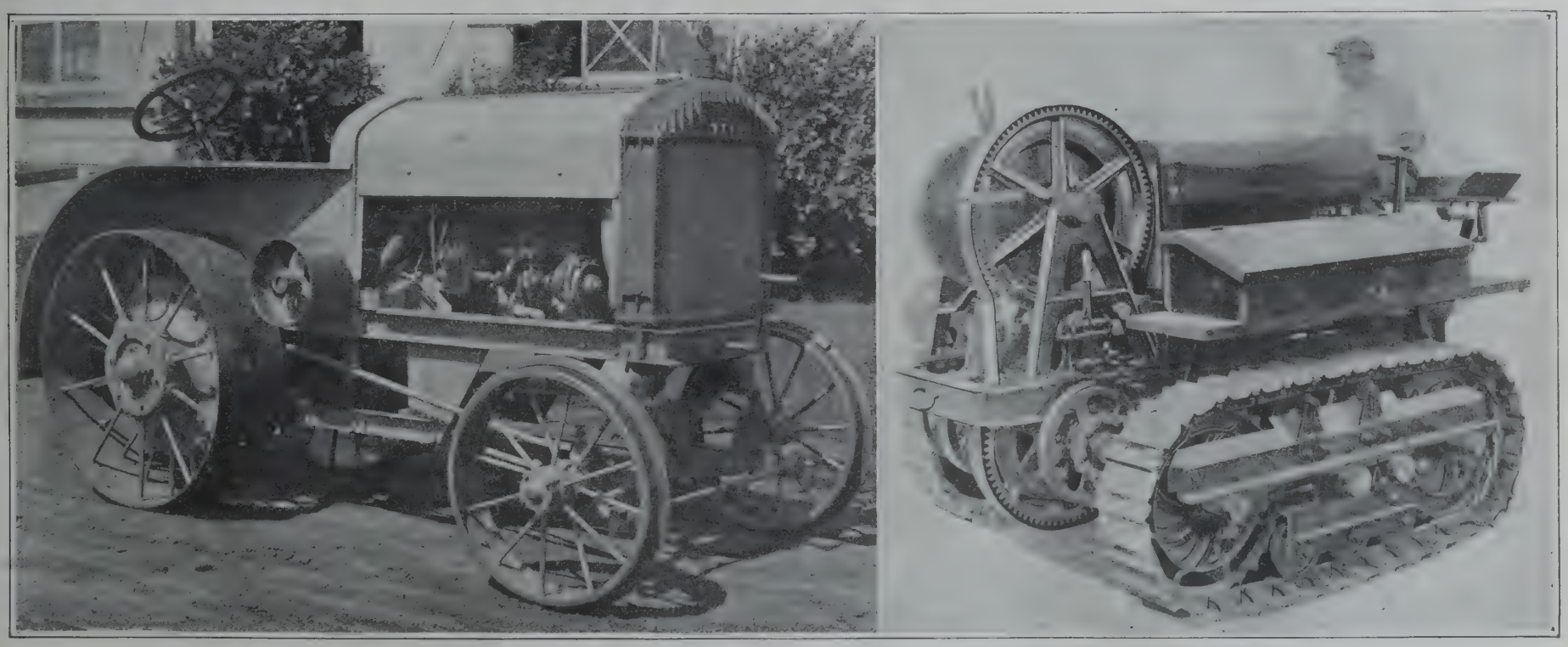

**Typical tractors of the wheeled and track-laying species now employed for agricultural and other purposes**

# Seventy-Five Years of Pure Science

## Some of the Things We Know Today That Were Not Suspected When the SCIENTIFIC AMERICAN Was an Infant

IF we compare the state of science today with that which existed in 1845, the first thing that comes to our attention must be the utter poverty of equipment of the former date as compared with the latter. In good truth the scientist of today ought to get results that were far beyond the reach of his grandfather, for he has tools of a character and of a sensitivity which his grandfather could never have pictured in his wildest dreams. It would be quite out of the question to catalog these; but we may at least mention a very few of the ones whose contribution to scientific advancement has been the greatest.

The microscope and telescope existed, of course, in 1845; but subsequent developments in the direction of improving the definition of the image in the former and of increasing the light-gathering power of the latter have almost made new instruments of both. The spectroscope, developed by Kirschhoff and Bunsen in 1859 along lines suggested by Fraunhofer fifty years earlier, is something at which even the present sophisticated age may well gaze in astonishment. That the light impulses sent out by different substances should be of different wave-lengths seems reasonable enough, and we know that if they are of different wave-lengths they must be of different colors. That the temperature and the pressure at the light source should make some difference in the impulses propagated seems equally reasonable; that a relative motion between source and receiving point should alter the apparent character of the received impulses likewise seems within the bounds of probability. But that a single small instrument of simple outlines should be set up which shall so analyze the light thrown into it that a mere scaling off of linear measurements shall at once give full information on all these points, and do this equally well whether the source of the light is at a distance measured in centimeters or in light-years—this really would seem, in the absence of performance, to push credulity too far.

Then, too, the physicist of 75 years ago had to depend upon microscopic scaling off, with all its inevitable errors, to give him minute measurements of dimensions. Today, through the work of Michelson based on the researches of Young of a century ago, we are able to use the wave-length of light as a measuring unit, and by the elegant method of interference fringes force millionths of an inch to stand out, clearly visible to the naked eye. This is a tool of which Michelson's predecessors could have had little or no inkling.

### The Permanent Observation

Another vast advantage of the present-day investigator in any field is that he does not have to make his observations hastily, while the observed phenomenon is occurring, depending for subsequent use upon such of these observations as he is able to remember or to jot down in the few seconds available for this. Automatic and permanent recording, not merely of the investigator's impressions, but of all the facts in the case, is always possible. If it is a matter of telescopic or microscopic or unadorned visual observation, the camera makes the permanent record, or if necessary, the motion picture machine is called in. If it is a matter of sound, the phonograph is at hand. If it is almost anything else in the world, means are always at hand for forcing the phenomenon under observation to impress its peculiar features on an electric current, which in turn records them in the shape of a jiggly line traced on a revolving drum, or in some other way that makes them equally permanent. Then in every case the investigator is able to survey his results carefully and slowly and as often as he pleases, under the most favorable physical and mental conditions, free from all rush and all fatigue; to place the results of many trials beside one another and compare them directly instead of through mere memory; to apply the most excruciating care to the measurements that are necessary to quantitative determination; to refer again and again to the precise records and reproductions of his experimental results during the hard process of drawing general conclusions from these.

In enthusing over the major items, we should not lose sight of the very great importance of the relatively smaller developments. A little thing like the selenium cell, with its ability to translate light into an electric current and reverse the process to get back the original impression in all its details, is of no end of value. The X-ray and the radioactive body are of less consequence as tools than as contributors to new theory on the nature of things; yet their rôle as tools is by no means an insignificant one. The man who constructs a little exploring coil which, by revealing the magnetic structure of a metal part, makes it possible to give that part a searching physical test without the destruction of the tested piece that always follows the older and cruder method of finding the breaking point by breaking, has given science a new tool of great power. The pyrometer furnishes a means of measuring high temperatures, the electric furnace a means of producing them, that were quite beyond the science of 75 years ago. At the other end of the temperature scale we have the work of Dewar, who shows us how to create an unprecedented degree of cold and how to study what takes place at these low temperatures. And so it goes; every branch of science has made enormous instrumental advances in the past seven decades.

*IT is a very large order to attempt the characterization of the entire scientific achievement of seventy-five years; it is obviously impossible save where the developments of the period considered show sufficient unity to make it possible. To an extraordinary degree the seventy-five years of the* SCIENTIFIC AMERICAN'S *life show this unity; and the word that describes their trend is* GENERALIZATION. *The whole tendency in every field of science has been to include more and more apparently isolated phenomena under a single broad statement, and to show that the things in this universe that are really unrelated are amazingly fewer. And no demonstrable end to this is even yet in sight!*—THE EDITOR.

### Laying the Foundations of Modern Physics

It is largely as a result of all this marvelous equipment developed since 1845 that one may survey the whole field of science and find hardly a single part of that field which has not been completely dug up and planted afresh in matters of fundamental theory during these 75 years. In the forties, for instance, the science of physics in so far as its elementary concepts are concerned was in a state of confusion. Mayer and Joule had just given to the world their determinations of the mechanical equivalent of heat, thus laying the cornerstone for the entire structure of the modern physics. It is difficult to conceive how physicists before 1842 made any progress at all, in ignorance of the relation between work done or energy employed, and heat produced. But even for many years after 1842, in one fundamental point there existed hopeless confusion, on account of the want of an adequate distinction between force and energy. Physicists had gradually acquired the doctrine of the indestructibility of energy; but this was expressed in terms of the so-called law of the conservation of force. Promulgated as one of the triumphs of science, this supposed law was far from satisfactory. The troubles of scientists in trying to reconcile this pronouncement with the facts, their comments and explanations in this connection, make curious reading today when we know that force can be created and annihilated at will, when we have learned to distinguish definitely between force and energy. But after years of work the distinction was formulated and a threefold system of units established for physics, the members being force, work and energy. These were definitely distinguished each from the others; and at once the great doctrine of the conservation of energy, unproved though it be, obtained universal acceptance by men of science and today is universally used as a working hypothesis, with proper modifications in the light of the latest developments.

It is impossible to dwell too strongly on this major achievement of the physics of the fifty years from the forties to the nineties. Until force was adequately distinguished from energy the doctrine of the conservation of energy could not be used, and it is precisely on this doctrine that the whole of the modern physics is constructed. It would be fair to term the theory the greatest discovery of the century in physics, and to name Lord Kelvin, the man who had most to do with its precise formulation and general acceptance, as the foremost physicist of the century—or at least the one who has left the deepest imprint on his science.

This, however, is but one thing that has happened to the physics of 1845. At that date the work of Young and Fresnel was sufficiently old to make the wave theory of light universally understood and universally accepted. And since the doctrine that light is a wave motion called for a medium for the waves, the luminiferous ether had been invented—invented seems really the word, since direct experimental evidence of the ether's presence was lacking from the beginning and has remained lacking. It remained for the decade of the fifties to put to the fullest use this perfectly continuous and perfectly incompressible and perfectly rigid and perfectly elastic medium which the physicist had postulated, by making it carry the electric current as well, in the shape of the waves which Clerk Maxwell indicated as the basis of this current. And where Clerk Maxwell had suggested the obvious conclusion to be drawn from this that light waves and electro-magnetic waves and presumably other yet-to-be-discovered waves were fundamentally the same, differing only in wave-length, it remained for Hertz to prove this, and to give real form to the very elegant conception of a long series of waves, substantially identical in nature, running from electric impulses hundreds of yards long, down through the shorter and shorter waves of wired circuits, of radiant heat, of visible light, and finally of the invisible ultraviolet portion of the spectrum that carries the wave-length far below the fifty-thousandth part of the inch. This generalization of many apparently diverse phenomena under a single caption, despite the atrocities that have been committed in its name by those who failed to understand its proper limitations, was a tremendous step in advance, and one thoroughly characteristic of the period in which it occurred.

The twenty-five years since the appearance of our fiftieth anniversary number have been almost as sharply marked off in the history of physical science as they have by the golden and the diamond jubilees of the SCIENTIFIC AMERICAN. For where the fifty years had been devoted to a laborious building up of the two generalizations outlined above, the twenty-five might well appear, to one not thoroughly alive to the full significance of what was being done, to be given over to efforts to tear down these generalizations. The older members of our staff remember well the opening gun of this campaign; in December, 1895, they participated in an informal editorial conference, at which the question was discussed whether to accept or to reject the wild yarn that had come over the cable from Germany to the effect that Professor Roentgen had discovered a new kind of light to which many substances ordinarily opaque were more or less transparent. When fuller details had come through, and the scientific world was able to assure itself that this extraordinary result was a fact, the tendency was generally to assign the X-rays a place in the table of wave-lengths, putting them at the extreme point of the short-wave-length end. But they were troublesome creatures; they seemed at the same time to be waves and not to be waves—to be at once electrical and material in nature. And here the physicist would have been held in suspense for a long time, had not the chemist been unexpectedly precipitated into the problem with him.

### Ordering the Elements

The decade of the 40's had found the chemist just come into undisputed possession of two tools of the greatest importance—the concepts of the atom and of the molecule. The very clear notions of how and why compounds are formed which resulted from these ideas, and from the knowledge of valency developed during the 50's, led to a precision in analysis and in terminology that had always been lacking. It led at the same time to clearer ideas on what constituted an element, and to the discovery through analysis of a number of new elements, extending the list of these to something like seventy. It made it possible both to distinguish with certainty between atomic and molecular weights, and to determine the former with greater precision than ever before.

As a direct consequence of all this Newlands in England, Hinrichs in America, Meyer in Germany, and Mendeleef in Russia had their attention called to a mathematical relationship which, though rough, seemed clearly to exist between the atomic weights.

Mendeleef was most successful in working out this relationship, and in showing that when the elements were arranged in groups with attention to atomic weights, physical properties recurred in a most striking manner. It is his name that is associated with the periodic law which he formulated, and which constituted the first of the great chemical advances of the period we are discussing.

On the surface this looked more or less like a step backward, a return to the days of the man who insists that there must be only seven planets because seven is a perfect number, or that there ought to be some connection between the arrangement of the seeds in an apple and the vertices of that particular one of the regular polyhedrons which strikes the individual fancy as most beautiful. But while many chemists were inclined to dismiss it with a shrug as being of such caliber, it did not warrant this summary treatment. It can be accepted as entirely rational that there should be such a connection as Mendeleef discovered running through the atomic weights and the properties of the elements—if only we are willing to interpret this state of affairs as indicating that the elements "are not separate bodies created without reference to one another, but that they have been originally fashioned, or have been built up, from one another [or from some common infra-elementary material] in accordance with some general plan." This was the big idea behind the periodic system, and this was the idea which the chemistry of the latter half of the nineteenth century, following that system, developed. It was an idea wholly foreign to the chemistry of 1845, and would have been regarded by preponderant opinion of that date as a survival of or a reversion to the concepts of alchemy. Its acceptance, with all the implications regarding the eventual possibilities of transmutation of some sort, is the logical outcome of the trend taken by experiment and discovery, and constitutes easily the major feature of 75 years of chemistry.

### Matter and Electricity

The major feature, perhaps; but by no means the climax. This came in the chemical world, as in the physical, more or less as an electric shock; and this in spite of the fact that just as Crookes and others had shown results largely anticipating those of Roentgen, Becquerel and others had really paved the way for the Curies. The precise terms of the discovery of radium, again like that of Roentgen, were for some time in doubt; it was not immediately clear whether radium gave forth energy alone, or matter alone, or an ambiguous combination of the two; nor whether it did this with or without permanent loss to itself. Accordingly there was a great deal of concern lest the law of conservation of energy, and even that of conservation of matter, should be shown to fail. Eventually the new discovery was boiled down to rock-bottom facts, collated with the X-ray development, and used as the moving force in further investigations designed to clear up the obscure points; and chemists were then in a position to wrestle with it in the search for its true significance.

There is no space here for any account of this strugle, but the most probable conclusions that have been drawn out of it must be set down as the summation of the physical and chemical development of 75 years. For these conclusions bring together the suggestion forced upon the physicist that matter and electricity are in some way related, and that forced upon the chemist that all the elements are in some manner of the same stuff. Without troubling ourselves too much about exact definitions of "nucleus" and "electron," "electricity," and "matter," it appears that the atom is composed of a nucleus that is mainly matter and one or more electrons that are mainly electricity. Presumably the nucleus and the electrons are identical for all atoms of all elements. With perhaps a little less confidence we may say that presumably some further facts will come out that will show a further degree of identity between nucleus and electron, between matter and electricity. For the present, if we cannot say that matter is electricity, we may at least assert with confidence that the distinction between different forms of matter is wholly an electrical one. And the observed facts of radio-activity and its allied phenomena are very nicely explained by assuming that the electrons are able to detach themselves and travel about "on their own" with some freedom under appropriate conditions.

A further development in line with this has come, in the immediate present, from the field of pure mathematics. It is altogether too early to attempt to place the Einstein theories in their permanent place. It is not too early, however, to say that these theories indicate a unity between apparently diverse things such as had never before been suspected. It shocks our sensibilities to be told that energy and matter are identical to the extent that we may write an equation showing how many ergs it takes to equal one gram; and that time and space are identical to the extent that we may write another equation showing how many seconds are the equivalent of one centimeter. Nevertheless, this is in direct line with the whole tendency of nineteenth and early twentieth century science, which has moved always in the direction of generalization, always in the direction of revealing that things previously supposed to be different are in reality not so.

The pure science of today is the applied science of tomorrow; hence one is somewhat in doubt as to just what may properly be included under the title of this article. It seems fair enough to say that pure science is science for its own sake, the desire to know for the mere sake of knowing, without any question of possible applications to the affairs of ordinary life. In this sense electricity was once a pure science, but today it is anything but that—its every fact and principle are put to work smoothing the path of the human race. But there are still pure sciences, sciences that are pursued just for the sake of driving the facts to their ultimate refuge. Of course the astronomer's findings are put to daily use in the determination of time and direction, and the geologist's are applied in the search for oil deposits, and the biologist's in plant and animal breeding; but this is something that the astronomer and the geologist and the biologist cannot control. There should not be great difficulty in steering a straight course between the pure and the applied; and surely astronomy is the science which is pure to the last degree.

### With Spectroscope and Camera

The astronomer of 1845 could turn his eyes on such a glorious past that he might have been pardoned for lack of confidence in his future. The century immediately behind him had been one of extraordinary achievement; but the invention of one instrument alone sufficed to enable the problematical future wholly to eclipse the past. The astronomer today turns his spectroscope upon a given star, and tells us precisely what chemical elements are present there, the approximate temperature and pressure under which they stand, whether the star itself is old or young as star-life goes, what stages it has been through and what it has yet to undergo, and how fast it is moving toward or away from us. On top of this he can usually manage a pretty shrewd guess as to how large and how bright it is and how far away from the earth. The astronomer of 1845, if asked for these data, would have protested that he could get them only by visiting the star in question. But today we bring the star into our laboratories here on earth, and achieve the same result that would be effected by going to the star. From an imaginative viewpoint, this might fairly rank as the most amazing thing in all science.

*SPECTROSCOPE and camera are merely two of the most vitally important, the X-ray tube one of the most spectacular, of thousands of instruments, scientific and practical, which have been placed at the disposal of the scientist since 1845. It is with these instruments that he has been able to make the tremendous advances that this story endeavors to record in barest outline; and no survey of the period would be complete that did not place the utmost emphasis upon the fact that the past seventy-five years have been an era of extraordinary instrumental development.*—THE EDITOR.

Hardly less important to the astronomer than the spectroscope is the procedure now opened to him of permanently recording—not merely the observations which he might have made, but billions upon billions of observations which, unaided by the camera, he would never have had time or ability to make. Tentative efforts in this direction were made by Arago, in France, and by the senior Draper, in America, in 1839, just before our 75 years commenced to run.

Real success waited until 1880, when the junior Draper in this country and Gill in South Africa made the first adequate telephotographs, taking as their subjects a nebula and a comet respectively. Today star plates by the thousands are in existence, covering all the heavens and all the time since the beginning of the process. No other method is seriously used for the exploration of the sky. For to the advantage, already discussed in connection with the general case, that it gives a permanent record, it adds a second, that this record can be as complete as desire and weather permit; and a third, that the camera is a better observer than the human eye. A single observer with an equipment of cameras is limited, in the amount of material which he can accumulate for future study, only by the number of telescopes available. And when we look through a telescope, with the trifling reservation that concentration of attention on a given part of the field may help a little, we see at once all that we are going to see; whereas the longer we follow a certain bit of sky with the camera, the more stars will, by the accumulated effect of the minute beams of light which they throw upon the plate, make an impression which shall rise above the threshold of microscopic visibility. When the astronomer examines, with a high-power microscope, a photographic exposure of several hours, he is going to see uncounted thousands of stars that no telescope will ever reveal to his eye. With this increased power of observation, and an automatic memory that extends back at least twenty years and is able to recall for him anything that he may wish to know about the appearance of any region of the skies at any date during that time—well, small wonder that he is able to extract from the stars secrets which must have seemed forever unattainable to the astronomer of 1845!

### The Riddle of the Universe

The photographic camera and the spectroscope have worked together in new attacks upon that fundamental question of the universe—whence, when, how, came the stars and the planets? The mathematical physicist too brings new resources of calculation to bear upon the problem, and is able to tell us that Laplace's nebular hypothesis, which our grandfathers considered as absolute truth and the crowning achievement of their cosmic science, is simply foolish, in that incandescent gas never does and never can behave in anything like the manner which this hypothesis demands. With this means of confining himself to physical possibilities, the astronomer has now a fairly definite idea of the course of stellar evolution and decay, and will point to this and that nebula and star and star cluster as illustrations of the several stages. And where the astronomer of 75 years ago thought he was on the point of placing dimensions to the universe, there has been a curious double overturn of opinion. Bigger telescopes and the camera so extended the visible field that no more than ten years ago a competent writer very properly said that all previous inferences as to the limitations of the sidereal system had been discredited, and that in spite of the wonderful instrumental advances, knowledge of the exact form and extent of the universe seemed less attainable than in the first half of the nineteenth century. Today, however, there is good ground for the belief that a concerted attack on the problem, with every mathematical and instrumental resource employed to the full, has at length struck bottom, and that as a tentative estimate of the extent of starry space we may set down some such figure as 300,000 light-years—which sounds much more impressive, though at the same time more meaningless, if we translate it into 2,000,000,000,000,000,000 miles.

The astronomer has collaborated with the geologist in estimating the time necessary for the earth and the rest of the universe to have passed through the various stages of which legible records remain in the rocks and in the skies. It may be laid down as a general principle that each generation since 1845 has felt obliged to throw out of court, as hopelessly inadequate, the most liberal estimate that the preceding one felt justified in making. In 1845 there were plenty of people who did not feel it inconsistent with the scientific viewpoint to believe that the universe was about six thousand years old and to set a date for its creation little if any less absurdly definite than the celebrated statement of the satirist to the effect that it took place at 10 A. M. on Friday the 16th of March in the year 4004 B. C.

Today it is quite out of the question to lay down anything approaching a definite consensus of opinion as to the age of the universe; figures ranging from a hundred million to a billion years are laid down as the lower limit and there really does not seem to be much that can be said definitely on the subject, except that, subject to correction by Professor Einstein, eternity is a long, long time, and that the universe has doubtless used the best part of it in coming to its present condition.

# The Mastery of the Skies

## How the SCIENTIFIC AMERICAN Has Been Privileged to Chronicle the Development of Airship and Airplane

**Lilienthal, the German experimenter who discovered the means of controlling the balance of flying machines, and one of his many gliders with which he made his gliding flights**

THE Burton family, encircling the fireside, read with unconcealed wonder the account of a hollow globe of oiled-silk filled with hydrogen gas, thus giving it a sufficient buoyancy to travel through the air. And they marvelled still more at the spindle-shaped saloon, suspended beneath the balloon, carrying 5,000 pounds of passengers and luggage. Twenty-five passengers in a balloon traveling at 100 miles per hour!

What of it? Nothing alarming or startling, in view of our present-day achievements. But the foregoing-mentioned facts were being read in the SCIENTIFIC AMERICAN of September 18th, 1845. Visionary as such a scheme seemed at that time, the editors of this journal had the foresight and courage to give it the stamp of their approval. They held that the seemingly impossible thing could be done, given the proper time and development which must necessarily precede any epoch-making invention.

Were they correct? History speaks for itself. Seventy-five years later, or to be exact, shortly before the dawn of July 6th, 1919, the Editor-in-Chief of the SCIENTIFIC AMERICAN stood out on Roosevelt Field scanning the early morning horizon for the coming of the monster dirigible, which was to mark the completion of the first westward transatlantic flight. Later, as the huge British R-34 dirigible strained at the hundred cables which moored her to Long Island soil, the SCIENTIFIC AMERICAN might well boast of a vision come true. For the R-34 in 108 hours traveled 6,300 air miles from East Fortune, Scotland to Mineola, Long Island, due to adverse winds. And on the passenger list were thirty officers and men, and a stowaway!

### The Path of Least Resistance

Always has it been man's ambition to fly with wings, emulating the easy flight of the bird. But man soon learned to his sorrow that he had not the muscular power to flap a pair of wings of sufficient spread to carry him through the air. And in the absence of any other form of motive power, man naturally gave up the attempt for the time being.

The free balloon, invented in 1783 by the brothers Joseph and Etienne Montgolfier at Annonay, France, proved to be a simple way of overcoming the pull of gravity which holds us hard and fast to the ground. Immediately men in many countries took up the balloon as a thing for speculation and experimentation. The heated air of the Montgolfier balloon was soon replaced with hydrogen, thus marking a very material step forward in the art since this gas lifts about 68 pounds per 1,000 cubic feet as against some 10 pounds for the highest temperature that is practical for a hot-air balloon. The use of coal gas for inflation, first made by George Green, an English aeronaut, in 1821, constituted another important advance; for though coal gas lifts only about 35 pounds per 1,000 cubic feet, its production is very inexpensive and its use sufficiently satisfactory for sporting purposes and aerial exhibitions.

John Wise, America's pioneer balloonist, invented in 1844 the rip panel. This is a ribbon covering a vertical seam in the upper half of the balloon, which, on landing, can promptly be jerked off to allow instant deflation and thus prevent dragging by the wind. This last invention virtually closed the experimental era of the free balloon, for this has not undergone any notable change in construction during the last eighty years.

The modern free balloon has a bag made of rubberized fabric or varnished silk and is equipped with a wicker basket in which are carried various instruments for recording barometric pressure and altitude, a compass, maps and ballast. Its size varies from 9,000 cubic feet to 80,000 cubic feet; this is the average, for much larger balloons have been built and successfully operated, such as the German "Preussen" in which Prof. Berson and Dr. Suring rose in 1901 to the highest elevation ever reached by a balloon—34,430 feet, or nearly seven miles. This balloon had a capacity of 300,000 cubic feet. Again, the largest hot-air balloon ever built was "Le Flesselles," which was launched at Lyons, France, in 1784 and measured 100 feet in diameter and 130 feet in height. Its volume was 590,000 cubic feet.

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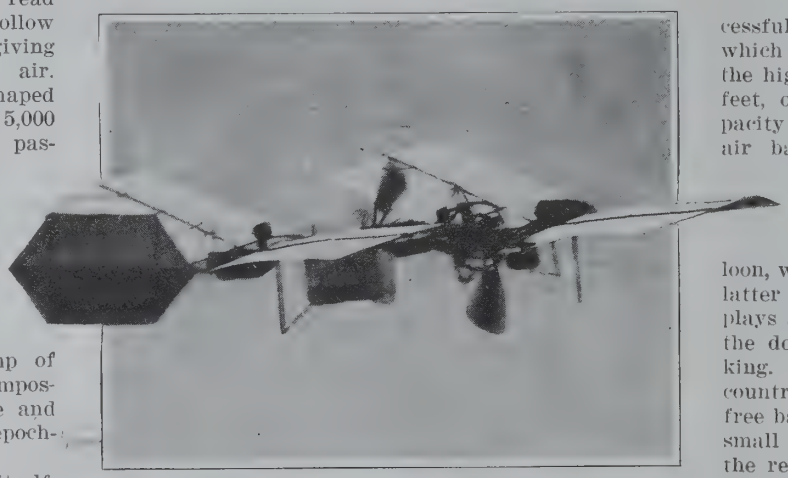
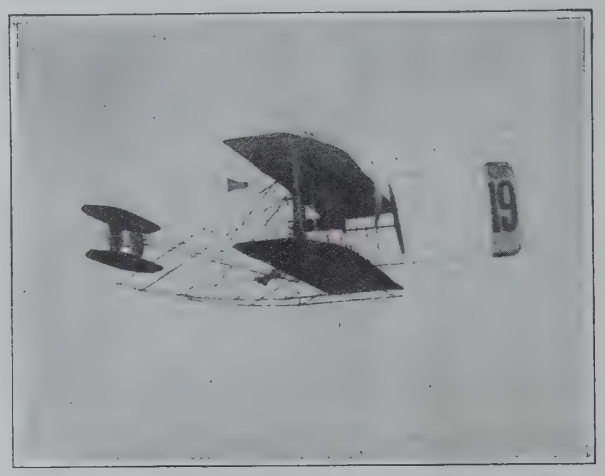
**The "June Bug"—the first machine built under Curtiss's direction, which, on July 4th, 1908, won the Scientific American Trophy for first public flight of one kilometer**



**The man-lifting monoplane built by S. P. Langley, in 1903, and which, but for its defective launching device, would have flown under control**



**One of the early Wright biplanes flown in 1908, both here and abroad. This machine was launched by means of a catapult and rail arrangement**

Despite the development of the dirigible balloon, which is a natural outcome of the free balloon, the latter has still a very definite field of usefulness. It plays a prominent part in the field of sport; indeed, in the domain of sport the free balloon has been called king. Annual competitions are held in the principal countries among the foremost balloonists. Again, the free balloon is used in scientific research, in which case small balloons equipped with scientific instruments of the recording variety are used to great advantage for investigating the constitution of the higher atmosphere. Some of the so-called sounding balloons have reached astounding altitudes; the world's record belongs since 1911 to an Italian sounding balloon which rose to an altitude of 114,900 feet.

### The Gas Bag and Modern Warfare

During the Civil war and particularly during the Franco-Prussian war the free balloon played an important part in the operations, thus establishing itself in the service of the soldiery for all time to come. The siege of Paris in 1870-71 brought forth the free balloon as a satisfactory means of transportation for passengers and dispatches over the German forces. By means of free balloons some 164 passengers were carried out of Paris, together with 3,000,000 dispatches. Out of 66 balloons, only five were captured by the Prussians laying siege to the city, and two were lost in the Atlantic. In fact, so great was the moral and material success of this enterprise that Bismarck threatened to shoot every aeronaut as a spy, and Krupp produced the first anti-aircraft gun.

The wide sweep of the horizon which a balloon affords to its occupants marked this craft upon its very inception as an ideal instrument for military observation. But as the balloon always follows the direction of the prevailing wind it proved necessary to secure it to the ground. In this manner came about the captive balloon. Originally, this was nothing more than a spherical balloon which was attached to the ground by means of a cable.

For the Paris Exhibition of 1878, the Frenchman, Giffard, built a gigantic sight-seeing balloon. This craft, which had a volume of 882,500 cubic feet, carried thirty-eight passengers at a time to a height of 1,600 feet, and was hauled down by means of a 300-horse-power steam winch. This balloon has remained the largest spherical of either free or captive type.

The defects of the ordinary captive balloon were overcome by two German army officers, Captains Parseval and Sigsfeld, who

**Zeppelin L-72, one of the present-day rigid dirigibles capable of crossing the Atlantic. This design, the outcome of the war, no doubt is the forerunner of the commercial dirigibles of the near future**

**British airplane mother ship "Furious," showing the flying-off deck forward and the landing platform aft. The airplane, it will be noted, lands on the platform, runs along onto inflated corrugated stopping cushion, and is brought to a dead stop by the safety nets. The airplanes are housed below**

produced in 1893 the so-called kite balloon—a craft which has proved so successful that it is now recognized to be an indispensable observation agent of every up-to-date army and navy.

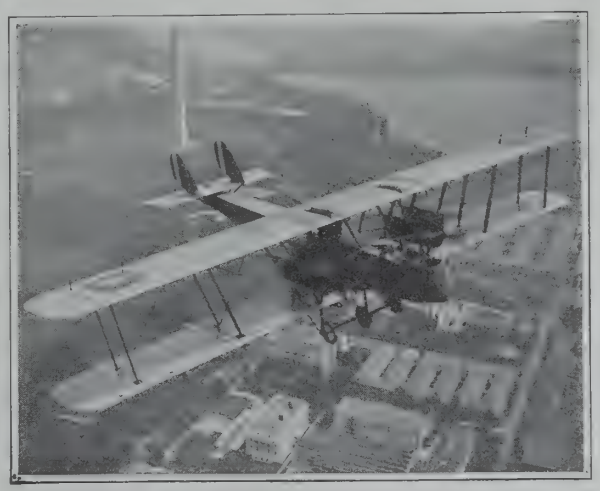
The kite balloon consists essentially of an elongated gas bag which is divided into two unequal portions, the larger of which (comprising about four-fifths the total volume) is filled with hydrogen, the remaining one-fifth constituting the ballonet, or air cell, and this is automatically inflated by the wind through a convenient aperture. The ballonet creates within the gas-bag an excess of pressure equal to the pressure of the wind plus the static pressure of the hydrogen, thus enabling the balloon to maintain its shape regardless of any wind the mooring cables can withstand. As air is heavier than hydrogen, the ballonet causes the balloon to assume an inclined position which enables it to counteract the depressing tendency of the wind. In order to keep the craft always head-on to the wind, a sausage-shaped pneumatic fin is fitted to the rear of the envelope, which is inflated the same way as the ballonet; longitudinal stability is further insured by lateral sails and a device similar to a kite's tail.

As a fire-control station for military and naval operations, the kite balloon far surpasses the airplane, for it affords a steady platform wherefrom field glasses or telescopes can be used to great advantage.

In the Great War the kite balloon was used on practically every front. On the Western front alone hundreds of them dotted the rears of the Allied and the German lines. Fortunately for the occupants of kite-balloons, who have no means of defending themselves against airplane attacks, suitable parachutes have been devised which permit them to jump out of the fired balloon and make their way to the ground in safety.

A great improvement was achieved in the performance of observation balloons in 1916, when Captain Caquot of the French Army, invented the kite-balloon bearing his name. This craft has a streamline shape and is fitted with three pneumatic fins at the rear, which do away with the cumbersome fittings of the German balloon. The Caquot balloon can stay aloft in much higher winds and possesses greater stability than the Parseval; its use proved such a success in the war that all the Allies adopted it and the Germans promptly copied it.

Put a power plant into a suitable free balloon and you have a dirigible. So it is quite obvious that the free balloon, sooner or later, gave birth to the dirigible of later-day aviation. And with the introduction of a power plant the balloon became a more positive means of transportation, since it no longer depended upon uncertain winds to take it in any direction they might elect.



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**A present-day twin-engined biplane—the Martin Bomber—in flight over Washington, D. C.**

### Free Balloon + Power Plant = Dirigible

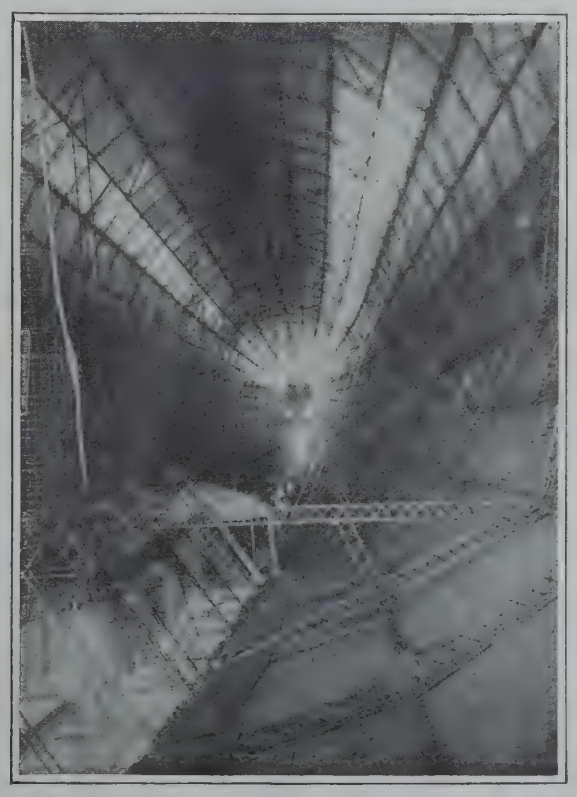
The basic elements of an airship are (1) an elongated gas-container, called *envelope*, streamline shaped in order to attain the greatest speed with the least expenditure of motive power and stability when under way; (2) one or more cars containing the power plant, the fuel supply, the crew and the passengers, as well as a commercial or military load; (3) a system of connection between cars and hull; (4) such means as will ensure the permanency of the hull's shape; and (5) such means of control as will effectually regulate the longitudinal and vertical equilibrium.

The dirigible more than any other modern machine represents the collaboration of almost countless inventors extending over several generations. Indeed, no one man can be accorded the credit for the dirigible. However, three men may rightly be considered as the founders of the science of airship construction. These were: General Meusnier, of the French Army, who in 1784 laid down the fundamental principles of the non-rigid airship; Colonel Renard, also of the French Army, who designed and built in 1884 the first airship that conclusively demonstrated its ability to navigate the air in any direction desired by the pilot; and Count Friedrich von Zeppelin, a German cavalry general, who devised in 1900 the rigid airship and brought it through persistent work to its present stage of development.

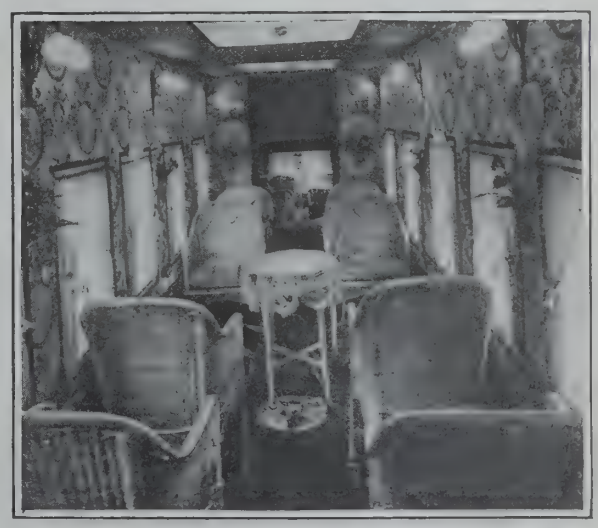
The space allotted to this broad subject of aviation does not permit us to enter into an exhaustive study of dirigible design and construction, but suffice it to say that there are two main classes of dirigibles, the rigid or structure airship, in which the permanency of the bag or hull is attained by means of a rigid framework covered with fabric which encloses a number of drum-shaped gas bags, and the semi-rigid airship in which the permanency of the hull is insured by maintaining within the flexible envelope a pressure superior to the atmospheric pressure.

(*Continued on page 362*)

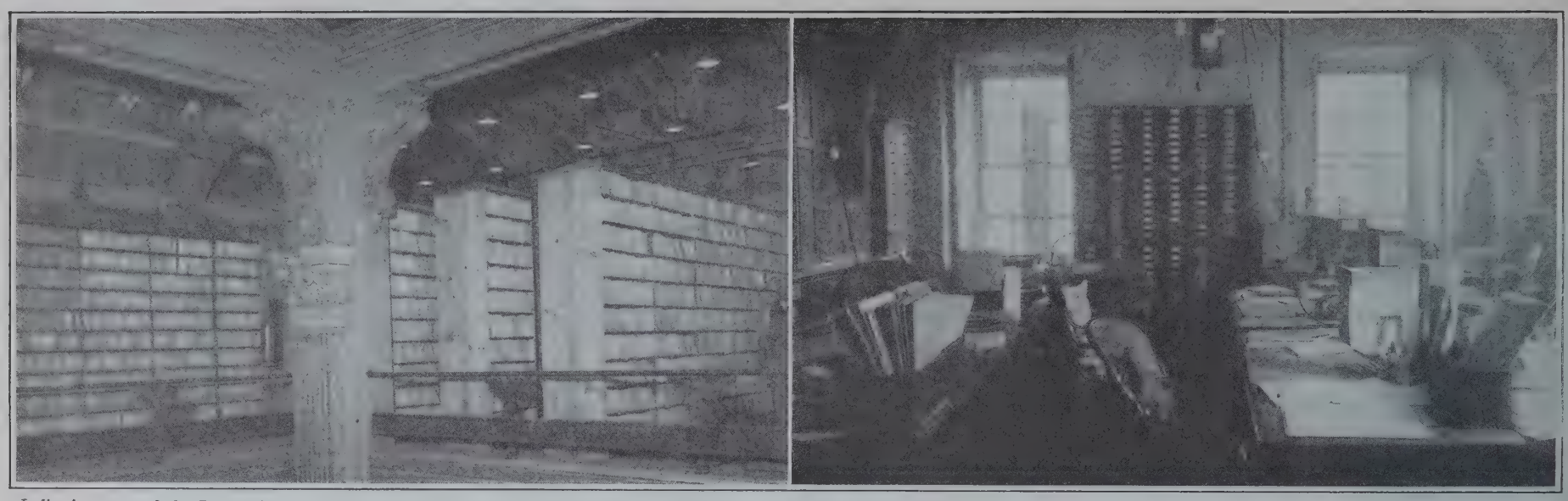
**In the chart room of the R-34 during the trans-atlantic journey from Scotland to Long Island**



**View inside the huge bag of the Zeppelin L-72, with the gas bags removed**



**Interior of one of the passenger-carrying airplanes now in regular use in France**



*Left:* A corner of the Patent Office, showing how thousands upon thousands of documents are filed away for reference purposes. *Right:* An examiner's room in the Patent Office. It is interesting to note that in 1836 the Patent Office became an independent bureau, headed by a commissioner, assisted by one examiner and six other subordinate clerks and employees

**Two glimpses inside the United States Patent Office**

# Seventy-Five Years of American Patent Administration

## How the System Has Developed from Small Beginnings, and What It Means to the Nation's Industry

By William I. Wyman

SEVENTY-FIVE years ago the leading industrial country was England. It was in that country that the Industrial Revolution began, due to a series of remarkable inventions of the most fundamental character which originated at about the time of the American Revolution. The inventions by Britishers of the spinning jenny, power loom, reverboratory puddling furnace and steam-engine—all perfected within half a generation—led immediately to the greatest of all changes in civilized history.

### The Industrial Revolution and Human Nature

The Industrial Revolution did everything but change human nature. It radically altered politics and history, and did a great deal to modify the appearance of old Mother Earth herself. England, the scene of this revolution, was its first beneficiary, and three-quarters of a century ago its predominance in industry, commerce and wealth was uncontested. The United States was just feeling its way then in manufacturing and machine production. But in the infancy of its industrial life this country presented a radically new system of patent procedure and protection, which tended powerfully to stimulate ingenuity and advance the United States to the foremost place in invention and manufacture. England originated the patent system, her inventions which caused the Industrial Revolution gave strength and body to the system and in turn made it the occasion for the development of the new era. The United States act of 1836, devised by Senator John Ruggles of Maine, constituting the so-called American method of granting patents, was the first vital departure from English patent laws. This act instituted the present organization of the United States Patent Office nine years before the founding of the SCIENTIFIC AMERICAN and in that short time demonstrated its virtues and possibilities.

The law it superseded and the prevailing procedure in all other industrial countries were based upon the "registration" system of granting patents without scrutiny of operativeness, examination of novelty or demonstration of invention. Except as it was made more effective by minor changes, the act of 1836 remains in larger outlines in the law of today; and except for alterations which shall more effectively carry out its purpose and principles, it will persist in the systems of the future. While the law did not fulfil the complete hopes of its creators, it was a pronounced step in the right direction and a decided jump in advance not only of anything that had previously existed, but that had ever been proposed. It was constructive legislation in the highest sense of that abused term. It provided an organization and a mode of procedure for which there were no precedents and presented a positive and clear cut plan for determining patent rights which was absolutely logical and complete and which in its larger outlines provided for every possible contingency. It sharply accentuated the advantages of a proper "examination" system by its vivid contrast with the signal failures of the previously existent "registration" regime. So marked was its success, so closely related to the progress of American industry, so intimately identified with and provocative of the genius of invention, that the so-called American method of granting patents became the standard practice for the whole world to emulate or admire. The only notable exception to this trend, the only highly progressive and powerful state which adheres in entirety to he old 'registration" system, is France. And while there may be no necessary connection between her industrial position and her patent system, it is a fact that she has lost relatively in recent years in the international race for economic precedence. And this in spite of the fact that no people are more ingenious, more original in conception or bolder in action. Even staid, conservative England has compromised and accepted partially the advantages of the examination system. The first country to be industrialized, the first to feel the impulse due to invention, the country to whom the greatest fundamental inventions of modern times are due, England had every reason to remain content with her centuries-old patent system. But she was being passed in the race by the newer industrial nations and she was compelled to alter her system in accordance with the methods which were conferring ascendency upon her competitors.

**The Patent Office Building, the erection of which was begun in 1836 and finished in 1840. This original structure forms the F Street wing of the present building**

### Property in Ideas

For the first time in all history the means for ascertaining and decreeing rights of property in ideas and promoting the objects of a system of patent protection was placed on an intelligent, scientific and adequate basis. Before this time, it was true that some measure of examination prior to the grant was indulged in. In Massachusetts and Connecticut, long before the Revolutionary War, patents were granted by the legislative bodies after a conference with the inventor and a scrutiny of the invention, while under the act of 1790 the Federal Government did the best it could to ascertain utility and the state of the art, but the efforts in these various directions to give valid basis for the patent were spasmodic and fragmentary. No facilities, organization or body of adequate law was ever provided before this time properly to initiate and carry on the "examination" system. This act provided a means for collecting the art, a personnel sufficiently trained to examine the same intelligently, and the machinery and procedure for scientifically endeavoring to give effect to the purpose of the law. That purpose was to throw on the Office the burden which the courts had alone performed, to determine the utility, novelty and patentability of the invention when and where the patent is granted, and, as one writer puts it, "To eliminate litigation 'before it begins.'"

The law of 1836 provided a dignified procedure, gave the grant a *prima facie* standing of validity, and if it did not start this country on its unprecedented industrial era, was at least the most powerful agent in stimulating inventive genius and conserving its fruits. Industrial civilization and invention are inseparable factors. One cannot be comprehended without the other. The present law may be defective and the means to administer it may be inadequate, but the fundamental principles upon which it is based are sound It only needs that it be improved in such detail as necessity indicates to make it the effective instrument that Senator Ruggles perceived it to be for the promotion of the comforts, well-being and progress of a civilized state.

The first commissioner of patents and the man who inaugurated the system under the act of 1836 was Henry L. Ellsworth. During his administration the vulcanization of rubber and the electric telegraph were invented and patented. In the short nine years preceding the 75-year era under discussion such a stimulus was given inventions by the new act as to excite the utmost admiration and wonderment of the Commissioner as he was about to retire from office. In the birth-year of the SCIENTIFIC AMERICAN, the second Commissioner of Patents, Edmund Burke, assumed office, so that the life of this publication is almost coextensive with that of the modern patent system.

A great deal of the early reports of the Commissioners was devoted to presenting agricultural statistics and information interesting to tillers of the soil. By law, the Commissioner of Patents was charged with this duty. Since that time, this activity became vested in a separate bureau and later in a department, while the office to which it was originally an appendage is still an obscure subsidiary to an organism to which it has no functional relationship.

### The Rush of Patent Business

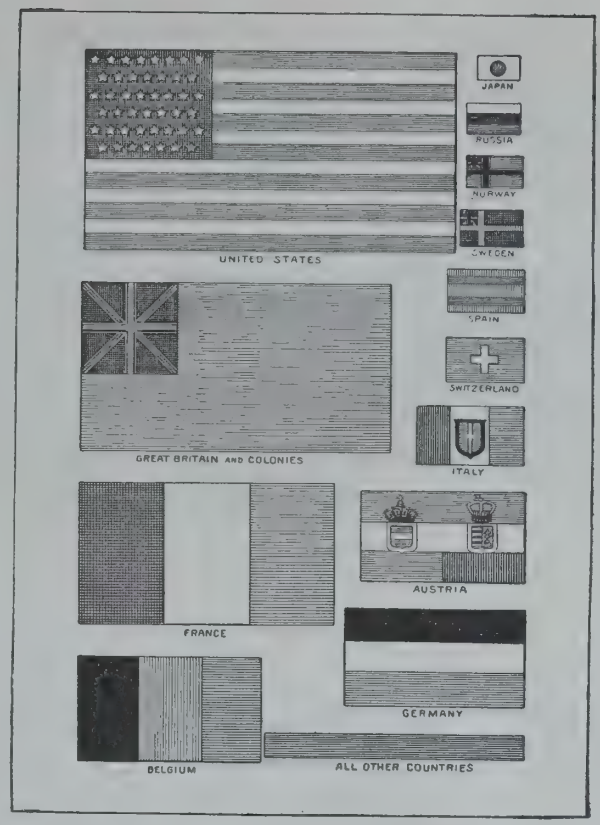
Even in the earliest days of the history of the office, the condition which has since become chronic, manifested itself. In one of his reports, Commissioner Burke complains: "The office is seven or eight months in arrears of its business and is daily becoming more and more embarrassed. Thus, I have in five separate communications to Congress and its appropriate committees within the last two years made full expositions of the embarrassed condition of this office growing out of its greatly increased and increasing business and the inadequacy of its force to perform its duties."

The fact is that the business presented to the Patent Office has always run ahead of its facilities of performance. Public opinion has failed to recognize the stimulating effect upon invention produced by the patent system and the excessive demands made in turn upon the office by the production of such stimulus. There has been a constant lag between the necessity of giving the office support and the furnishing of the required assistance.

In 1851, in the annual report of the Commissioner, were published the beginnings of the present Rules of Practice. In that year, also, the reviews of the advances in the arts by the examiners were omitted in the annual reports. These reviews were comprehensive summaries of the inventions patented during the year and were attempts to appraise and analyze the different contributions of the patentees. They indicated much labor and enthusiasm and gave testimony to the extreme regard the examiners must have taken in their pursuits and the wide scope of their interests.

In the year 1852 there were filled 2639 applications for patents. Commissioner Hodges commenting upon this showing said: "Some find it difficult to conceive that this flood of discoveries and improvements is still to maintain its progress. They look for a falling off and doubt whether there is room for the continued exercise of inventive genius. Every step taken, instead of bringing us nearer to the close of our career, does but open new scenes to explore and prepare the way for new triumphs." It was good prophecy, based upon a thorough consideration of fundamental factors, but even this bold seer would have hardly dared to imagine an income of applications thirty times as large in the course of less than three generations.

In 1861, act of March 2, considerable changes in the organization of the Patent Office were effected. A permanent board of examiners in chief was created to hear appeals taken from the decisions of the primary examiners; the present filing fees were established; and the term of the patent grant was extended to seventeen years. Commissioner Holloway, who served during the Civil War, made the pregnant observation in one of his annual reports that the introduction of labor-saving devices through the exercise of invention was the means whereby a million men could be released from industry without a reduction of output. His successor, Commissioner Theaker, speaks in the same tenor when he remarks: "The ingenuity of inventors has attempted, by mechanical means, to so control and operate the various machines with which our country abounds, that they have to a very great extent supplied the places of the persons who were made victims of war."




**Comparative volume of patents granted by various countries, shown by the relative sizes of the flags, up till the time of the world war**

Immediately after the Civil War, the business of the office increased by leaps and bounds. It was a period also of questionable practices and moral lapses in both politics and business, and the Patent Office fell under the spell of prevailing influences. In 1869 Colonel Samuel S. Fisher was appointed, through the recommendation of the Secretary of the Interior Cox, Commissioner of Patents. Colonel Fisher inherited a condition arising from maladministration and rapid growth of the business of the office. He was Commissioner for but one and one-half years, and, although his administration was one of the shortest, it was by far the most fruitful of accomplishment in the history of the office.

Before he entered the Patent Office, chaos had descended upon its administration; its procedure was unscientific, unstable and hopelessly involved; its conclusions uncertain and disturbing; while its functions generally were performed inefficiently and with exasperating dilatoriness. Charges were openly made of favoritism in its conduct, while the public could not free itself of suspicions of dishonesty attaching to its methods.

### A Critical Period

He first addressed himself to the task of improving the personnel of the examining corps. As the so-called "American System" of granting patents is based upon a consideration of the prior art, it is evident that its efficiency is dependent upon the character and qualifications of the men who make the examination. This aspect is the vital factor in the whole theory. Commissioner Fisher sensed its importance at once, and proceeded to introduce a system of selecting appointees which was based solely upon the fitness of the candidates for the designated position. As he stated in his Annual Report for 1869, referring to the qualifications of examiners, "It becomes very important, therefore, to secure competent men for positions of such responsibility. An examiner should be a man of great patience, industry and honesty, of varied and yet thorough mechanical and scientific attainments, with a good knowledge of patent law, and a mind capable of the nicest discrimination. Though many men offer themselves for the position, but few are fit to fill it."

The tests he constituted were probably the first ever established for entrance into the Civil Service that were rigid, searching and competitive in character. They comprised all the elements of the modern merit system and anticipated its general introduction by almost a generation. It was only through the opposition of a public-spirited official now and then who chanced to be in power and who dared to interpose that the logical result did not intervene and disrupt the whole administration of government. One such official was Gov. J. D. Cox, Secretary of the Interior, who had induced Colonel Fisher to accept the Commissionership. The latter knew only too well how important to the industrial interests it was that the work of the office should be conducted by men of technical and scientific capacity and of high character. And in his efforts to provide a personnel of the desired attainments, he was supported without qualification by his immediate superior.

The result of Commissioner Fisher's policy was shown in the character of the new members of the corps, who in all the requirements of the position readily demonstrated a superiority over those in office who had come in under the old order. Secretary of the Interior Cox, who was a powerful barrier to the progress of many a corrupt influence and who was most anxious to improve the methods of government administration, gave his testimony of the effect of the new policy in the Patent Office in the following words: "No one could become even superficially acquainted with the organization of that important bureau without seeing that a spirit of emulation and zeal had taken the place of a listless and negligent performance of duty." In reviewing the history of those days, one cannot but help noting how far we have advanced in the ethics of government administration. Those who are despairing of the capabilities and rectitude of the office-holding class have no basis for their pessimism. On the contrary, there is good ground for optimism. A most casual comparison of conditions then and now shows an immense improvement in the personnel, both in efficiency and honesty, and a decidedly more wholesome atmosphere.

Commissioner Fisher and Secretary Cox were mostly responsible for initiating this movement, which led to such important results in improving the standards of public taste and executive

(Continued on page 364)

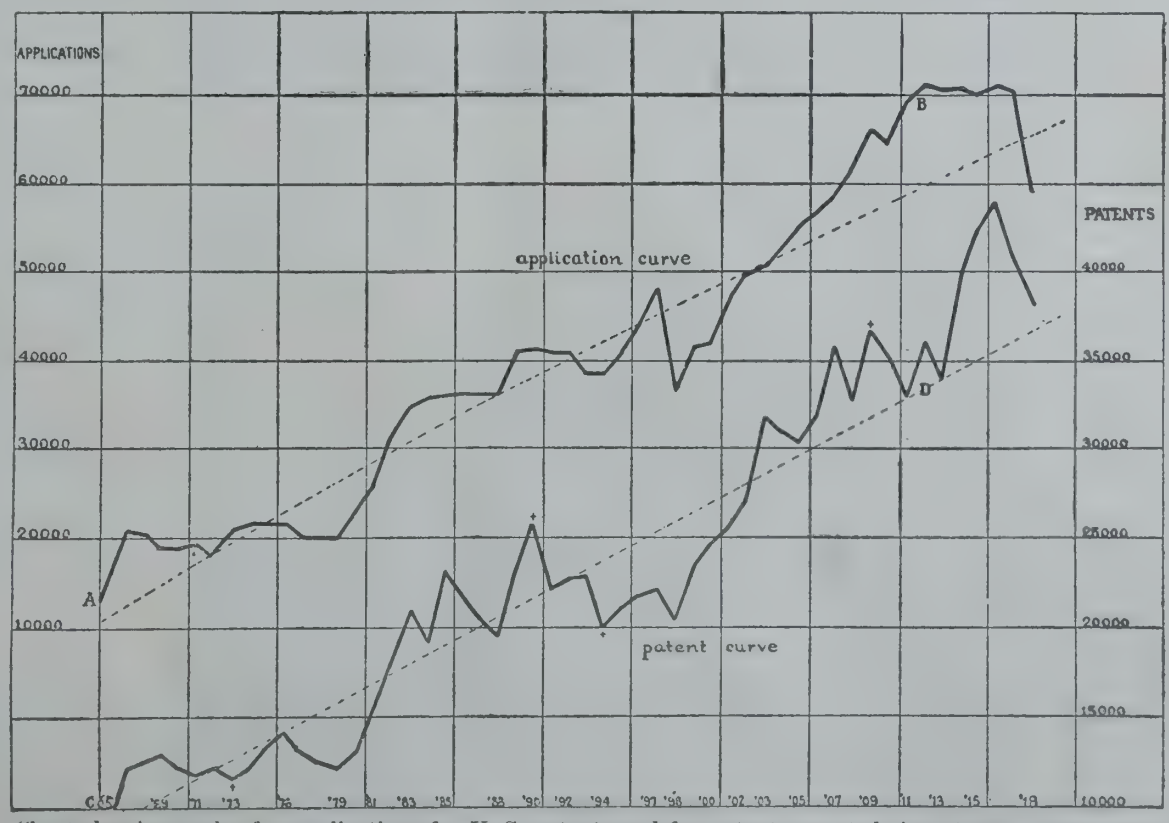



**Chart showing a plot for applications for U. S. patents and for patents granted since 1865. Upper curve represents applications for patents and re-issues, and lower one represents patents granted excluding re-issues. Dotted lines represent what might be called the lines of normal increase**

# The Diamond Jubilee of the Scientific American

## Three Quarters of a Century's Service to the Cause of Invention and Popular Science

Alfred Ely Beach,
a founder of Munn & Co.

SEVENTY-FIVE years ago occurred an event which was to set its unalterable imprint on the history of American invention and American progress — the founding of the SCIENTIFIC AMERICAN. It is doubtful if there are ten other periodicals which can boast so long a life. "Long life" is here used advisedly; for, at the end of seventy-five years we find the same ideals, the same devotion to the production of an accurate scientific and technical newspaper. This publication first started the idea of a service department, and nearly a million readers have asked for information, and rarely have they been disappointed. "Service" is, in fact, the keynote of the success of the SCIENTIFIC AMERICAN; for the cardinal idea is to conduct the paper in such a manner that it shall be of the highest possible benefit to the business man, the inventor, the manufacturer, and the general reader.

From time to time we get requests from institutions of learning for information relative to the early history of the SCIENTIFIC AMERICAN, for class study. This is the highest compliment which can be paid, and it is to give material of like nature that the present brief article is penned.

We celebrate in this issue the founding of the SCIENTIFIC AMERICAN, which took place in 1845. The journal was a weak and puny affair, however, when it was purchased by Orson Desaix Munn and Alfred E. Beach for a few hundred dollars in 1846. The paper was conducted by them as long as they lived, and since then by the descendants of the former partner.

It is logical that the first office should be in the "Sun" building; for the proprietor of that virile paper was Moses Yale Beach, father of Alfred Ely Beach. The first beginnings were small, the page being about twice the size of the present SCIENTIFIC AMERICAN, the whole paper consisting of only four pages. What we call the "net printed edition" was easily carried to the Post Office by one of the two enthusiastic founders. Journals of any kind were a rarity, and a scientific paper a wonder. The slogan of the first issue was that the "SCIENTIFIC AMERICAN is the advocate of industry and the journal of mechanical and other improvements."

Apparently there was not much industry to advocate or many mechanical improvements to record; for the editor found space enough to publish poetry, dissertations on temperance, and brief articles on such curious topics as "The Utility of Tribulations," "The Influence of Fashion," "Street Beggars," "Oriental Servility," and "Church Benevolence." When the SCIENTIFIC AMERICAN was first published the great achievements of the century were Davy's discovery of the electric arc light and of electrolysis; Oersted's and Ampere's electro-dynamic discoveries; Daguerre's method of photographing; Henry's and Faraday's discoveries in induction; and Joule's determination of the mechanical equivalent of heat.

Some of the advertisements afford interesting reading today and are interwoven with the warp and woof of progress. Advertising increased so that an apology was printed for carrying two and one-half columns! Eight lines cost only 50 cents—payable in cash, let us hope. Advertisements could not exceed 16 lines, and cuts could not be inserted at any price whatever.

### How the Patent Department Was Created

Because it was the only scientific paper of its kind the offices soon became a meeting place for inventors. Out of this intimate relation sprang the necessity of creating a special department for inventors, a department to give advice on the patenting of inventions and on patent law. From its very inception that department has proved the most successful patent bureau ever established. Among its clients have been such distinguished men as Samuel F. B. Morse, inventor of the telegraph; Elias Howe and A. B. Wilson, famous for their sewing machine inventions; Capt. James B. Eads, the distinguished builder of the great Mississippi bridge; Capt. John Ericsson, the designer of the "Monitor"; Dr. R. J. Gatling, inventor of the Gatling gun; Peter Cooper Hewitt, inventor of the mercury arc light; Thomas A. Edison, and others too numerous to mention.

Although the partners of Munn & Co. are members of the Bar, the law practice before the Courts is conducted by an associate firm under the name of Munn, Anderson & Munn.

Orson Desaix Munn,
a founder of Munn & Co.

United States Patent Office and Munn & Company's first office in Washington
(From an old print of 1859)

Patent Department of Munn & Company in 1849 (From a contemporary print)

The Scientific American offices at 37 Park Row, from 1859-1882

### The Scientific American and Inventors

Many of the disclosures are of historic importance for example take A. B. Wilson, who came to New York from Pittsfield, Mass., amid the derision of his neighbors. He came to the offices of Munn & Co., who secured for him a patent which served as the foundation stone for the great Wheeler and Wilson industry, and the world first heard of it through the SCIENTIFIC AMERICAN of November 24th, 1849. In his early days came Thomas A. Edison, and in 1877 he one day appeared with a small package which on being opened proved to be a machine and announced itself by saying: "Good morning. How do you do? How do you like the talking box?" The story of "Mary and Her Little Lamb" is not apocryphal, but Mr. Edison's favorite began "A soldier of the Legion lay dying in Algiers." The SCIENTIFIC AMERICAN Editors were among the first to see the electric incandescent lamp; the Edison dynamo, and the kinetoscope, and a score of other interesting inventions.

The inventions of Mr. Alfred E. Beach must not be passed by as they were of considerable importance and included one of the first successful typewriters, and the tunnelling shield which made possible his Broadway tunnel that was built exactly where trains now hurtle through and in and out of the City Hall Subway station on their way to the outlying boroughs. "Rapid transit" was evidently a problem as early as 1845, but 1870 saw the fruition of their dream. The short experimental tunnel was only a block long; but the cars actually ran. It was reserved for electricity to make subway traffic a commercial reality. Probably the pneumatic system would have been a failure, but this idea for rapid transit was thirty years ahead of the times. Thanks to the then all-powerful Tammany Hall, the scheme was defeated and elevated railways were built instead, much to the wrath of the Editor.

The SCIENTIFIC AMERICAN advocated better railways and helped to mold public opinion to such great undertakings as a line linking the Atlantic and Pacific coasts. The Panama Canal was also advocated as far back as 1846.

In 1845 the SCIENTIFIC AMERICAN began publishing articles on the automobile, such as it was then, and year after year space was given to the ideas of inventors who, groping in the blackness of futurity still had a clarity of vision which was phenomenal. It was through the SCIENTIFIC AMERICAN that they learned of the successes, trials, and failures of the pioneers, such as Cugnot, Trevithick, Church and Lénoir. When, at last, in invention's own time the automobile *did* appear it seemed to the readers not like a sudden apparition, but a vehicle with which they had always been familiar. Aerial navigation early fascinated the readers, even

from the first numbers, so that, for over fifty years it was the only periodical that took the airship and airplane seriously. Impractical ideas were freely criticised, and great sums of money were saved by honest advice which often resulted in the abandonment of useless plans.

### The Scientific American Airplane Trophy

With the object of fostering the art of aerial navigation, the SCIENTIFIC AMERICAN offered a magnificent trophy, which is illustrated herewith, under the auspices of the Aero Club of America, and on July 4th, 1908, Mr. Glenn H. Curtiss won the trophy for that year for flying a distance slightly more than a mile in his biplane, "The June Bug," which is illustrated elsewhere. In 1909 Curtiss again won the cup for flying a distance of 25 miles in a closed circuit, and in 1910 he won the cup for the third and last time in connection with his flight from Albany to New York, when he covered a straight away distance of 74½ miles without stop, which was phenomenal in those days. Mr. Curtiss having won the competition for three years secured permanent possession of the trophy.

### The Scientific American and Its Subscribers

From the very inception of the SCIENTIFIC AMERICAN the editor and the subscribers have been more closely associated than is usual, even in these days of paternal magazine editing. The periodical was always regarded by the publishers as something more than a mere commercial venture. They have always felt that they owe a duty to the subscribers, and a duty that did not end in giving an amount of printed matter equivalent in value to the price of an annual subscription. Accordingly, no letter asking the editor for information is allowed to go unanswered. Often the response entails an amount of research worth many times the amount of the subscription.

### The Scientific American as an Educator

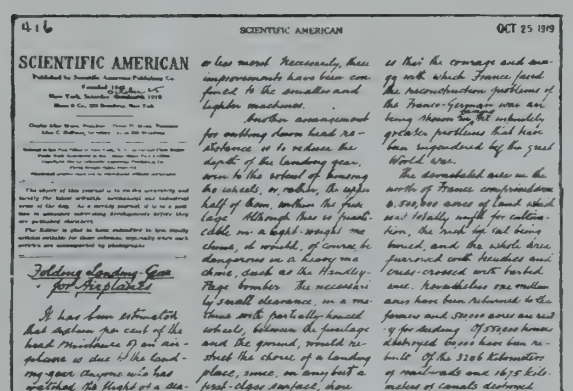
For several decades the SCIENTIFIC AMERICAN stood practically alone in the particular field which it covered. Launched in a new country, destitute of great libraries, great museums, or great universities, it served to a limited degree, it may be, but with distinct success, the purposes of all three. Not a few of the men who stand at the head of the great industrial institutions of the United States recall the hopeful days of their boyhood and their young manhood, when their chief source of instruction in the great happenings of that world in which they were about to make venture was the SCIENTIFIC AMERICAN.

**Scientific American Trophy for heavier-than-air flights, won by Glenn H. Curtiss**

THE ILLUSTRATED LONDON NEWS, Dec. 6, 1919.—921

## FIGHTING A PRINTERS' STRIKE WITH THE TYPE-WRITER: A CURIO.

BY COURTESY OF THE "SCIENTIFIC AMERICAN."



SCIENTIFIC AMERICAN

Folding Landing-Gear for Aeroplanes

It has been estimated that eighteen per cent of the head resistance of any aeroplane is due to the landing-gear, anyone who has watched the flight of a dirigible must have noticed how carefully he streamlines himself by straightening out his legs against the atmosphere. It only will be that the action of the birds supported the possibility of doing something to the kind with the landing-gear of the aeroplane. It may be remembered that, some few years ago, the editor of this journal suggested that the landing-gear might be hinged to the fuselage, so that it could be drawn up against the undercarriage by means of a connecting rod and piston, actuated by compressed air.

In the intervening years much thought has been given to this problem, and, today, there are several machines which carry folding landing-gears of more

SCIENTIFIC AMERICAN

THE STORY OF THE BARTRAM OAK

HOW A LITTLE EXACT EXPERIMENTAL SCIENCE SOLVED A PROBLEM OF LONG STANDING

By Dr. Arthur Hollick, New York Botanical Gardens

A REPRESENTATIVE GROUP OF OAK LEAVES OF DIFFERENT TYPES

LEAVES OF THE BARTRAM OAK (LEFT) AND OF THREE OTHER SPECIES

**WITH AN EDITORIAL IN LONGHAND AND OTHER LETTERPRESS IN TYPE-WRITING: PAGES FROM A LITHOGRAPHED NUMBER OF THE "SCIENTIFIC AMERICAN" PUBLISHED DURING A STRIKE OF NEW YORK PRINTERS.**

Owing to a strike of printers in New York, over a demand for increased pay, many American papers recently had to suspend publication. The "Scientific American," however, which has never missed an issue in 74 years, adopted an ingenious plan to avoid doing so. A prefatory note in the issue for October 25, four pages from which are reproduced above on a reduced scale, says: "The copy has been prepared by the editors on their trusty typewriters; and from this copy photographic transfers have been made on a lithographic stone. . . . We believe that this is the first time it (lithography) has ever been used in this manner, to produce the inside of an ordinary magazine. In this process the entire page becomes in effect a single illustration . . . We present the editorial page in direct reproduction of the original long-hand manuscript by the senior member of the staff." Some of the stock advertisements appeared in ordinary print, but these were already set up in type before the strike.

**How the Scientific American got along without compositors and pressmen during the printers' strike of the autumn of 1919**

Thousands of men who are now engineers and manufacturers received their first inkling of mechanical or electrical engineering from the pages of the SCIENTIFIC AMERICAN. Thomas A. Edison has related that as a boy he used to walk three miles to the post office every week to get his SCIENTIFIC AMERICAN. For seventy-five years issue after issue has explained with a simplicity that has appealed to every earnest student unfamiliar with the phraseology of more technical periodicals and books how apparatus of all kinds are constructed, and how such devices operate.

### Exposing Swindlers

As the SCIENTIFIC AMERICAN ministered to the intellectual requirements of a pre-eminently practical nation, so it guarded its financial interests when they involved science or machinery. Swindling schemes, based on supposedly revolutionary inventions, are encountered with less frequency than formerly, chiefly because we have a large class of trained technical men to fall back upon for expert advice. Thirty-five years ago it was otherwise. The late John W. Keeley, of blessed memory, who talked with the glib obscurity of an Indian Swami and was possessed of the audacity of a Cagliostro, was the prince of these swindlers. Year after year the SCIENTIFIC AMERICAN ridiculed his "etheric vapor," his vibrators, his resonators, and the mysterious forces that served to discharge his etheric weapons and to operate his engines. The editor took the trouble to build a duplicate of Keeley's "etheric gun," to prove that it was operated by compressed air. When Keeley died in 1899, still gaining the ears of a rapidly dwindling public, still living on the spoils of the mechanically ignorant and credulous, the SCIENTIFIC AMERICAN made a thorough examination of his laboratory at 1420 North Twentieth Street, Philadelphia. Every piece of flooring was torn up ruthlessly and every nook and cranny searched. The investigation turned out exactly as the SCIENTIFIC AMERICAN had predicted twenty years previously. Keeley's "etheric vapor" proved to be compressed air, and the man was proven to be a charlatan. There were other schemes besides Keeley's—all of them forgotten now, but as alluring to the unwary investor. In exposing them the SCIENTIFIC AMERICAN probably saved many a reader from serious financial loss.

### The Scientific American and the War

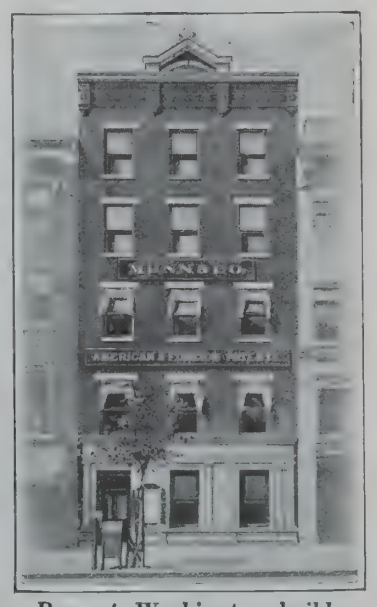
For two or three years prior to the terrible catastrophe of 1914, the editors had been very much interested in "preparedness," and had quietly amassed a fund of information and valuable data which was to prove of much use in the troublous years to follow. Scarcely had the cables announced the fateful news that Europe was aflame, than preparations were begun to treat the war in an accurate and scientific manner, and every member of the staff threw himself into the work with the greatest enthusiasm. The famous "War Numbers" are still preserved in libraries as among the most valuable of written memorials of the world-war. The sale of the earlier War Numbers was enormous, and helped to educate an entire people into the serious business of war, which was so little understood and which was so vitally necessary. The number of illustrations on war subjects went into thousands, and the best talent in the way of professional soldier and sailor writers was obtained. The entire collection of these thousands of pictures has been given to Princeton University, and the process of transfer is still going on.

Our entry into the war resulted in even greater efforts to inform the American people, and the editorial rooms of the SCIENTIFIC AMERICAN became a great clearing house where meritorious inventions and devices were speeded to the proper governmental agencies, and the merely chimeric plans were discouraged.

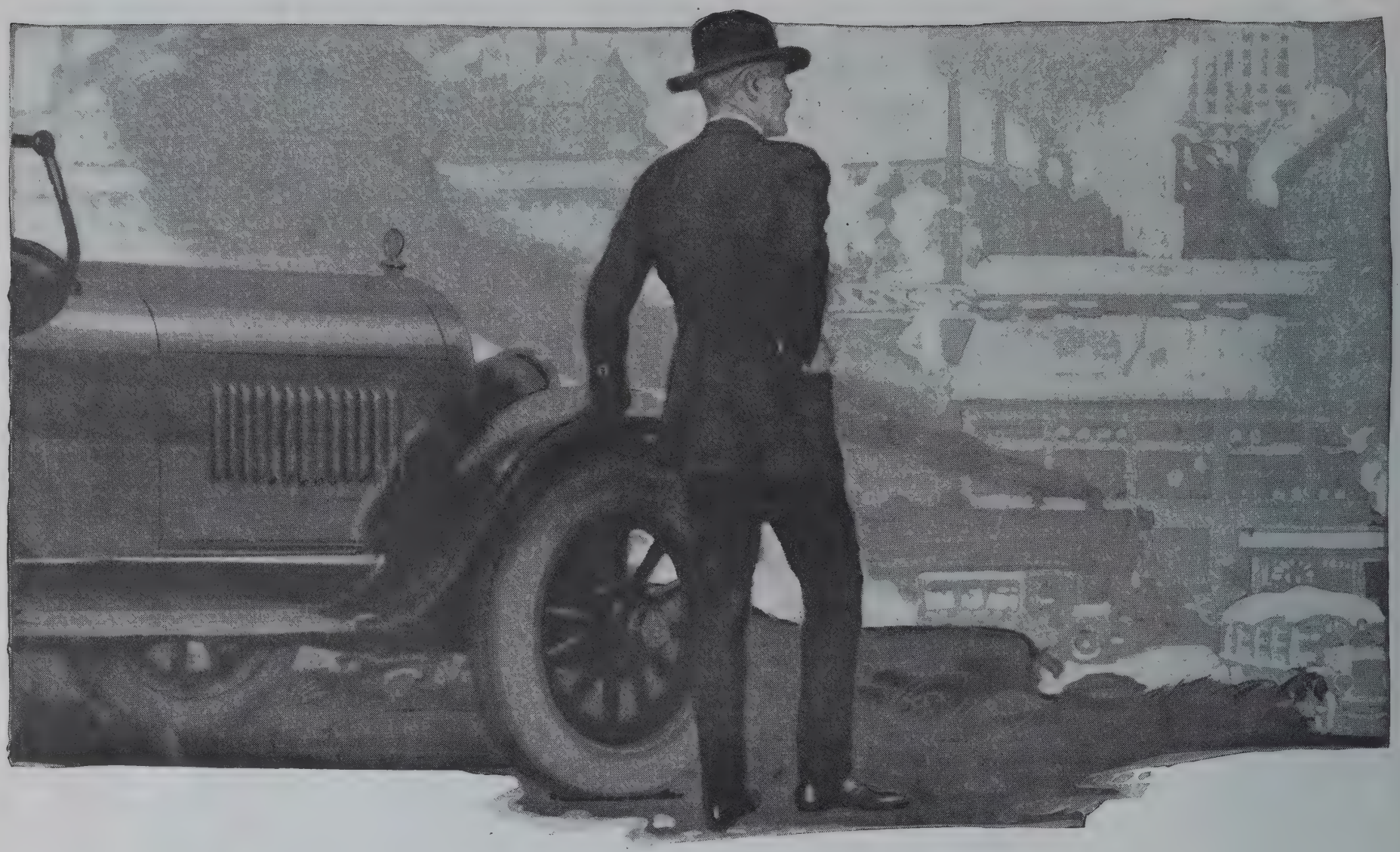
### Labor Troubles Are Overcome

Perhaps the most serious mishap the SCIENTIFIC AMERICAN suffered in all the seventy-five years of its existence was the printers' strike in the autumn of 1919. The compositors ceased working almost without notice after the pressmen had struck. If the compositors had not struck it would have made very little trouble; for we were calculating on working the paper by lithography, using the "offset" process for both type and illustrations. Our hopes were blasted, however, when type could not be set. Our editors' minds moved quickly, and in a surprisingly short space of time they evolved a plan which made typesetting in the emergency unnecessary. The matter was first "roughed out" on a typewriter, so that the approximate amount of space could be allotted, and then it was retyped with the same care as a hand compositor used in justifying his lines and spaces. Troublesome "run-rounds" were conquered and even the "fuzziness" of the textile ribbon was obviated by the sub-

(*Continued on page 366*)



**Present Washington building of Munn & Company and the Scientific American**



# Faith

MEMORY sometimes swings back to days when the automobile was nothing but "another crazy idea." When the few who took it seriously were objects of the misplaced sympathy of friends, and of unfriendly comment by the general public. When the legal rate of speed in many big cities was not to exceed seven miles an hour. When the man whose horse ran away at the sight of a horseless carriage always had the jury with him.

Those early days mean something to us now because to believe in the future of the atuomobile meant a great deal, then. To point a business in a new direction, seaward without a compass, took something more than courage and resource. It took the same vision, the same purpose, that were actuating those who were spending their days in the shop and their nights at the drawing board, producing the very beginnings of a new kind of transportation. It took *faith!*

During the last score of years the automobile industry has made a place for itself from which it can never be dislodged. It has done something more than develop a new mechanism to serve convenience,

# TIMKEN

or whim. *It has produced a new and fundamental transportation method, whether for people or things.*

It has made a daily contribution to the health and welfare of every person who lives in the civilized world. It has made Better Service between men, and between peoples, a fact instead of a theory. It has justified the faith of those who saw in it an agency that would realize the dream of a *Railway Without Rails.*

The reliable passenger car and truck builders, and every manufacturer who produces good equipment for their completion, are in the same business as the railroads. It has taken hard work, a lot of it unseen and unsung, to put them there. Most of those who took off their coats in the early days have never had time to put them on again.

The demand has been insistent for automotive transportation that should be increasingly better and more reliable. Each unit of the industry has had to organize for service. Engineering has made tremendous strides. Production methods have evolved that are the wonder even of those intimately concerned with them. Every day has meant twenty-four hours of progress.

Now comes a further development of the fundamental idea, which will make possible machine methods, and larger harvests, on every acre of farm land, cultivated and uncultivated, in the world today. The opportunity for service which lies before the tractor industry is as magnificent as any American business has ever faced.

It seems a long way back to the days when most people were saying, "the automobile will never work." *But we remember when faith in our product was all we had with which to anticipate the refined, fast-moving, powerful motor vehicle.*

Manufacturers of automobile, truck, and tractor have already surmounted their gravest difficulties. Commerce and industry, and the individual, recognize that the usefulness of the self-propelled vehicle has established it as a utility, and as an essential. The world can no longer get along without it.

***Faith today is founded on fact!***

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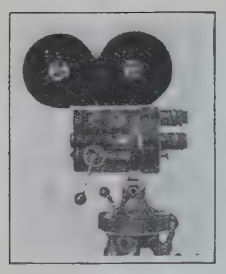
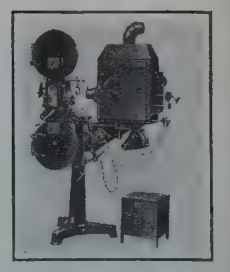
# BEARINGS



# From Wet Plate to Motion Pictures

## Some of the Milestones That Accentuate the Development of Amateur and Professional Photography



IT required an exposure of six minutes in strong sunlight to make a portrait of Miss Dorothy Catherine Draper. But that was in 1840, and her's was the first photograph of a human face. Compare that achievement, by Prof. John William Draper, with the remarkable snapshots made by anyone with a two-dollar box camera today, and you have a condensed summary of the development of photography during the past four score years.

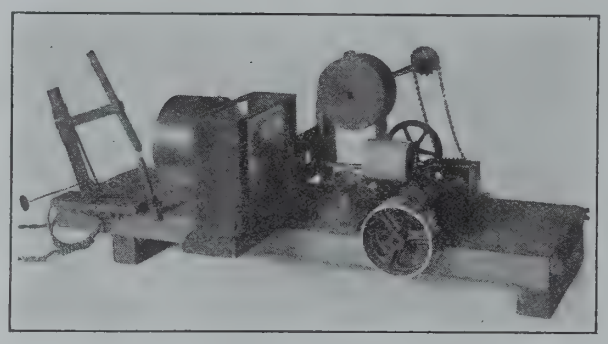
Photography does not start with the work of Professor Draper, nor does it start with Daguerre. Indeed, the origin of photography, or more correctly the origin of the camera, dates back to the middle of the sixteenth century when an Italian philosopher, Battista Porta, exhibited his *camera obscura* to the crowds that flocked to his house in Naples. All he did was to put a tightly-fitting shutter on his window, so that no light could enter except by a small hole which he had cut in the center of the shutter. He did not use a lens; yet the rays of light entering the room showed an inverted image of outdoors on the opposite side of the room. And even Porta's *camera obscura* is not the first attempt at the camera principle, for there are records of previous experiments of this kind.

At any rate, the *camera obscura* was the basis of photography. There remained the problem of recording the image in some suitable manner so that it might be made permanent.

So it may be said that photography proper starts with the work of Joseph Nicéphore de Niepce, who has been called the father of the art. His process appeared in 1824. In the Niepce process a silver-faced copper plate was coated with asphalt dissolved in oil of lavender and dried. It was then exposed to light in the camera, or in the case of an engraving, by superposition. Thereupon it was washed over with a combination of one part of oil of lavender and ten parts of petroleum. The picture was next rinsed in water and dried, preparatory to being placed in an iodine fuming box until the bright silver ground turned black. On removing the part of the asphalt remaining, the lights and shadows of the picture appeared in their proper relation, or instead, the plate was etched and printed as in ordinary etching.

### Daguerre—His Process and His Work

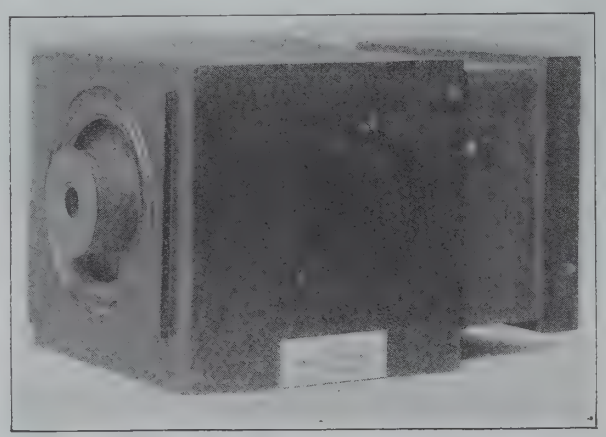
Then came Daguerre, whose name is so well remembered whenever photography is mentioned. It was in 1839 that Daguerre published his process. A copper plate, one surface of which had been silvered and highly polished, was fumed with iodine and then exposed in the camera, followed by the development with vapor of mercury and fixing in a solution of hyposulfite of soda. The solvent action of hyposulfite on the silver haloids was discovered by Sir John Herschel. The exposure required about fifteen minutes. Niepce and Daguerre then collaborated in the development of photography, so that some of the credit of having developed the daguerreotype belongs to Niepce.



This projector, exhibited by C. Francis Jenkins, in 1893, contained the essentials of the present-day machine shown at the upper right-hand corner of this page. Note the carbon arc, condenser, sprockets, intermittent movement and general arrangement. A water condenser was used to reduce fire hazard ever present with exposed celluloid film

**A pioneer machine which marked the beginning of the modern projector**

Soon after this, however, by the addition of bromine to the iodine by Goddard in 1840, and chlorine by



This camera was the first Daguerreotype apparatus made in the United States, making its appearance in 1839. Focusing was accomplished by having the box made in two sections, one sliding within the other

**Compare this early camera with the latest motion-picture camera in the upper left-hand corner**

Claudet in 1841, the plates were made more sensitive; indeed, in the year 1840 we find Dr. Draper making daguerreotype portraits in from twenty to ninety seconds. It was M. Fizeau who discovered that by treating the daguerreotype with double hyposulfite of soda and gold, it was made more permanent and very much more beautiful.

We come next to the calotype or talbotype, the invention of Henry Fox Talbot. Until Talbot's process was published in 1840, there was no such thing as printing in photography; that is to say, but one copy of a picture was made at each sitting, and that was the original exposed in the camera. Talbot introduced the photographic negative from which an unlimited number of prints may be made. According to Talbot's process, a solution of nitrate of silver was prepared, brushed over a sheet of paper, and dried. Then the paper was dipped in a solution of iodide of potassium, washed in water, passed between blotting paper, and dried. This was called iodized paper. When the paper was required for use, it was washed with a solution of nitrate of silver fifty grains, water one ounce, acetic acid one-sixth of an ounce. This was called "Solution A."

"Solution B" was a saturated solution of gallic acid in cold water. The two solutions were mixed in equal parts, just before using. Talbot called this "gallonitrate of silver." The iodized paper was treated with this solution and again dried. The paper was then exposed in the camera and developed with the gallonitrate of silver and fixed in hyposulfite of soda. Talbot found later that, by waxing, the paper negative was rendered more transparent, so that it gave better results in printing.

The use of collodion as a vehicle to hold the silver haloids upon plates originated with Frederick Scott Archer in 1850, although the idea was suggested by Gray the same year. Albumen paper had already been introduced by Blanquard-Everard in 1848.

Various photo-lithograph and other printing processes were invented at about this time, with a number of inventors taking part.

### Better Prints and How They Came About

George Wheaton Simpson is credited with working out the printing-paper process as early as 1861, using collodion for the purpose. Abney, in 1881, worked out printing paper with gelatine. The present developing papers—papers which, unlike the printing papers, do not show the image until they are properly developed, but which are so much faster and easier to handle, requiring only gas light or electric light in place of sunlight—came some time later. One of the most successful of these papers was that of Dr. Leo H. Baekeland.

Carbon printing in its present form appears to be the product of many minds. Mungo Ponton in the year 1839 discovered that white paper treated with a solution of bichromate of potash darkened when exposed to light. The next was the discovery that gelatine, gum and other bodies were rendered wholly insoluble

(*Continued on page 366*)

*Left:* The modern motion-picture studio where schedules are maintained irrespective of the weather and sunlight, through the agency of large banks of powerful lights. In southern California, where good weather abounds throughout most of the year, the studios are outdoor affairs with simple screens above to diffuse and reduce the intense sunlight. *Right:* A battery of projectors and a stereopticon machine in the operator's booth of a leading motion-picture theatre

**The motion-picture film from its manufacture to its consumption, or in other words, from studio to screen**

*How many men in your plant work standing in their own light?*

*How many men in your plant work under a blinding glare?*

*How many men in your plant grope for their tools in semi-darkness?*

*How many men in your plant carry work to windows for fine measurements?*

# Four Important Questions For Every Employer

Above are four stop-you-in-your-stride questions. If you have not read them, do so now. They have an important bearing on your production, your spoilage and your accidents. If your plant is incorrectly lighted, your net profits are being affected by some or all of the above conditions.

Do you realize that an improperly lighted factory costs *more* for illumination than one that *is* correctly lighted? It's a fact. Tests prove it. Here are the figures. Poor lighting is costing you 12% *less* production, 25% *more* spoilage and 25% *more* accidents. Translate this into dollars and you have a cost many times the price of a complete 100% efficient Benjamin Industrial Illumination equipment. In other words, you are paying more for the doubtful privilege of inadequate illuminating service than you would for the best the illuminating engineering world affords. Can you afford it? We hardly think so.

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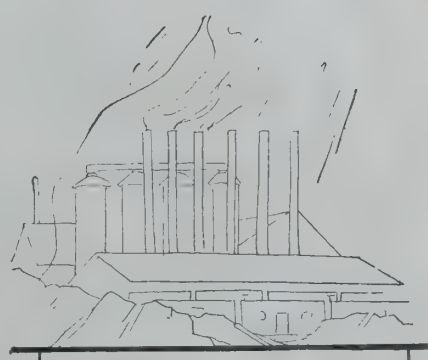

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*Immediate shipments make possible immediate installations.*

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

### Electrical Devices

SWITCH.—J. SCHNEIDER, 412 Walnut St., Roselle Park, N. J. This invention relates to high tension switches of the plunger type, its object is to provide a disconnecting switch arranged to combine maximum rigidity with minimum of weght and allow of conveniently opening and closing the switch. Another object is to maintain the opening members in perfect alinement when the switch is opened or closed thus insuring perfect electrical contact. Another object is to protect the contact making parts from moisture, dust, or other extraneous matter and to render the plunger self-cleaning.

THERMAL CIRCUIT CLOSER. — W. P. WEBBER, 147 Hancock St., Brooklyn, N. Y. An object of the invention is to provide a heat-controlled fire alarm device which may be conveniently held either in a vertical, horizontal or any intermediate position such as on a ceiling or side wall, so that said device will be responsive to a predetermined increase of temperature either within a room or between the walls or ceiling or partitions, to cause an electric circuit to be completed.

### Of Interest to Farmers

PLANTER.—F. H. SCHUTTER, Pleasant Valley, Iowa. The invention relates more particularly to planters for planting onion sets. An object is to provide means whereby a great number of onion sets can be planted in a relatively short space of time. A further object is to provide an onion planter that is simple in construction, efficient in operation and one that can be cheaply made.

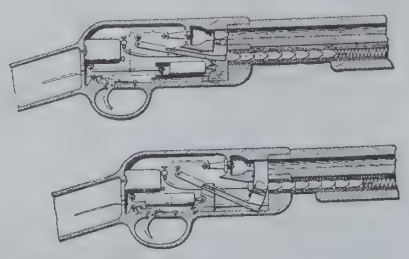
AGRICULTURAL IMPLEMENT. — R. B. MASON, 19 West Patriot St., Somerset, Pa. The invention is adapted for use with a threshing machine. It consists of a sheaf loader adapted to travel over the ground and gather the sheaves into a container. A sheaf distributer receives the sheaves when the loader is backed up to the distributer and the sheaf discharge gate is opened.

DRAFT-COUPLING.—J. W. BULLER, Hillsboro, Kans. The principal objects of this invention are: to provide means for automatically releasing a movable drawn member from power means for arresting the former, and to prevent wrecking a plow when its progress is arrested independently of the tractor means during the progress.

### Of General Interest

TENT AND HAMMOCK.—L. E. TRIMM, 677 E. 21st St., Brooklyn, N. Y. The invention has for an object the provision of a construction wherein the device may be used in its combined capacity as tent and hammock or may be used separately. Another object is to provide a tent and hammock arranged to be supported by ropes to suitable trees or supports, the arrangement being such that the hammock may be used as a bed in the tent or as a canopy or fly for the front of the tent.

RIFLE.—H. H. JONES, Holland, Ore. The principal object of the invention is to provide a simple yet highly efficient and durable rifle which will utilize the forms of expanding



CENTRAL LONGITUDINAL SECTIONS OF THE GUN, SHOWING A BULLET IN POSITION TO BE FIRED, AND BEING LIFTED FROM THE MAGAZINE

gases to drive the bullet from the barrel. A further object is to provide a gun in which the gasolene or other fuel used is mixed with air, and supplied to a combustion chamber at the breach of the gun, thus making it unnecessary to provide cartridge cases for the bullets to contain the explosive powder for impelling them.

PROCESS AND APPARATUS FOR METAL PLATING.—R. J. PIERSOL, Houston, Pa. The invention relates to a process for the plating of one metal with another metal which consists in enveloping the metal with the higher melting point by the fused bath of the metal with the lower melting point, said means being heated *in vacuo* to a temperature between their melting points. The device consists of a vacuum jar, a container placed in the jar adapted to contain a fused material, and means for lowering the second material into the first mentioned fused material.

DISPENSING CAN CLOSURE.—J. H. HOWARD, 2138 Perry St., Jacksonville, Fla. An object of the invention is to provide a device which when operated, opens the outlet of the can, causes a forceful ejection of a portion of the contents thereof and then closes the outlet. A further object is to provide a dispensing can closure which causes a uniform discharge at each operation and prevents wastage through careless operation.

SHELF.—F. GRAMMICH, 499 Vandervoort Ave., Brooklyn, N. Y. The invention relates to a sheet metal shelf so formed that comparatively thin sheet metal may be made to possess the necessary strength to sustain a considerable load. The object is accomplished by folding the sheet metal at one or more points in such manner that it will present members serving to stiffen the shelf as well as to give under support thereto.

HUMIDIFYING APPARATUS.—V. W. McADAMS, 218 So. Clarkson Ave., Denver, Colo. An object of the invention is to maintain a desired degree of humidity in a show case, more especially intended for tobacco, cigars and cigarettes, or the like by automatically increasing the moisture on the one hand or supplying a drying heat on the other hand, the moisture supplying means and the drying means being governed by a hygroscopic controller.

PENCIL SHARPENER.—J. SONTHEIMER, R. No. 5, Lincoln, Neb. The general object of the invention is to provide a sharpening edge in a tubular member ground so that the sharpening edge is presented at the edge of the opening produced by the grinding, whereby the sharpener may be used in different ways for sharpening a pencil. The sharpener is embodied in a tubular pencil attachment having pocket clips so that it may always be ready for use simply by slipping the clip fitting from the pencil.

CLUSTER BACK FOR JEWELRY.—O. P. BAILER, cor. Main St. and Jefferson Ave., Memphis, Tenn. The invention relates more particularly to the cluster back used in setting cluster tops in various mountings. The principal object is to do away with use of a necessity for solder, thus reducing the cost of manufacture. Another object is to provide a cluster back which is interchangeable and can be quickly applied to or removed from any form of setting, and which will simulate the facets of a full gem.

### Hardware and Tools

LOCK FOR METERS, ETC.—H. H. ROE, address Podlashue & Nicholson, 22 Bureau St., Pretoria, South Africa. The invention has for its object to provide locks for a number of special purposes, as for instance, water and gas meters, pressure gages, time recorders, handcuffs, motor car hoods, bicycles and the like; the construction is of few parts and easily operated. Another object is to provide a single key and single hand-operated member, with a manually actuated bolt held normally in locked position and a key operated screw.

VALVE FOR PNEUMATIC TOOLS.—W. S. WHYTE, 1128 W. 14th St., Bedford, Ind. This valve is adapted to be inserted in a hose or conduit to control the flow of compressed air or other motive fluid to a pneumatic drill or the like. Provision is made for the gradual admission of compressed air to the drill to effect a variance in the power stroke of the drill.

WRENCH.—L. DOONAR, Bend, Ore. This tool is specially designed for use in removing the nuts which hold the bearing caps on the connecting rods of an automobile engine and particularly for use in connection with number four piston of a Ford automobile which is known in the art to be particularly inaccessible.

ANTI-RATTLE CATCH.—C. J. HAGSTROM, Maple Ave., Glen Cove, N. Y. This catch is particularly adapted for use on doors, swinging windows and the like. The bolt of the catch is pivoted and is held in normal position by means of a spring. This makes the projecting end of the bolt bear against the socket piece in the jamb and prevents the door from rattling.

### Heating and Lighting

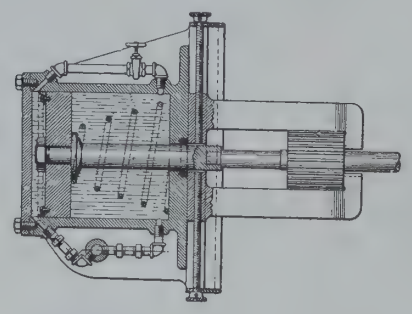
GAS HEATER.—C. M. MOGNI, 325 W. 4th St., New York, N. Y. The object of this invention is to provide a new and improved gas heater more especially designed for use in laundries and other establishments for heating sad-irons and like devices. The heater is arranged to produce an exceedingly intense flame to insure a quick, effective heating of the sad iron.

RADIATOR.—C. C. MANKER, Mayfair Apts., 40 St. James St., Los Angeles, Cal. Provision is made in this invention whereby oil or gas burners may be used in the ordinary steam radiators now in common use for producing a proper steam heat. Means actuated by the steam in the radiator control the volume of oil or gas fed to the heater, thereby producing automatically a uniform heat.

OIL BURNER.—C. C. MANKER, Mayfair Apts., 40 St. James St., Los Angeles, Cal. This oil burner may be applied to various uses, such as cook stoves, heating stoves, furnaces and the like. It dispenses with the use of an auxiliary pressure such as that supplied from compressed air, the arrangement being such that the pressure of the gasified fuel is sufficient to force the gas into the combustion chamber and at the same time to entrain a requisite uantity of air.

### Machines and Mechanical Devices

HYDRAULIC GEAR JACK.—A. W. HILLIARD, R.R. No. 2, Wheelersburg, Ohio. An improved hydraulic jack is provided by this invention adapted to strip or remove a gear, pinion, cam, collar, commutator core, or various other devices from the shaft carrying



IMPROVED HYDRAULIC GEAR JACK

the same. The invention provides adjustable means for engaging and holding the gear or other device against longitudinal movement while the shaft is removed by hydraulic means.

WIRE-DRAWING MACHINE.—D. C. SULLIVAN, G. L. HAWKINS, and W. J. MACMILLAN. Address Almion Engineering and Contracting Co., 25 Church St., New York, N. Y. By means of this invention two wires may be simultaneously drawn with the same source of power. The construction is such as to allow of stopping the reduction and removing either of the wires without stopping the drawing or reducing operation of the other wire.

### Medical Devices

TONGUE DEPRESSOR.—C. MACM. BUGBEE, Springfield, Vt. The invention comprehends a tongue depressor having such form that it may be made up inexpensively and be used for depressing the tongue under such conditions that a thorough inspection can be made at any and all stages of the use of the device.

### Prime Movers and Their Accessories

VAPORIZER FOR HEAVY OILS.—C. C. MANKER, Mayfair Apmt., 40 St. James St., Los Angeles, Cal. The invention relates to vaporizers for heavy oils such as kerosene and the like, for use in connection with automobile engines or gas engines in general. An object is to provide a simple device by means of which the engine may be started on the low grade oils, thereby obviating the necessity of carrying additional fuel, such as gasoline, for starting purposes; the device also dispenses with the ordinary carbureter.

INTERNAL COMBUSTION ENGINE.—R. P. GRIEVE, 327 E. 22nd St., Brooklyn, N. Y. The invention pertains more particularly to a piston construction of an internal combustion engine. It is the object of the invention to improve the construction of pistons in two piston engines in such manner that one of the pistons is adapted to be protected by the other piston. It is a further object to construct a superpiston in such manner that its radiating surface is greatly increased contiguous to the walls of the cylinder in order that the same may be more effectively cooled.

VALVE SPRING LIFTER.—G. T. EUARD, c/o M. R. Deyo, Peoria, Ill. An object of the invention is to provide a device which is especially adapted for use in connection with the valves of internal combustion engines, such as are employed in automobiles, but may of course be adapted for various other valves. A further object is to provide means for lifting the pressure disk on the valve stem against the action of the valve spring, so as not to exert any angular or torsional strain on the parts.

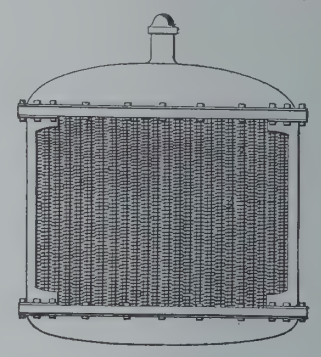
### Railways and Their Accessories

SAFETY DEVICE FOR CATTLE AND RAILWAY CROSSINGS.—J. I. DOMINGUEZ, Calle Maipu 671, Buenos Aires, Argentina. The invention relates to a device for preventing cattle or animals from gaining access to the interior of tracks. The invention essentially consists of a plain grating provided with rotary rollers and so balanced in its conjoint that when an animal should step thereon a part of the device will descend and the animal will recede when noting that it has stepped on a false floor.

CATTLE GUARD.—J. I. DOMINGUEZ, Calle Maipu 671, Buenos Aires, Argentina. This invention relates to a device for preventing cattle or the like from entering the tracks of railways by the openings left at the level crossings. The device provides a grating so held in suspense that the same may shift or oscillate in any direction so as when simply stepping with the foot thereon it will cause the animal to lose equilibrium and getting frightened will withdraw therefrom.

### Pertaining to Vehicles

AUTOMOBILE RADIATOR.—C. COSTELLOE and S. G. STOLL, 560 Morton Court, Hammond, Ind. An object of the invention is to provide an automobile radiator having as one of the prime features, the ability to easily remove



A FRONT ELEVATION

the top and bottom tanks so that the tubes may be readily reached for replacement and repair. Another object is to provide a radiator with means for simultaneously radiating the heat and adjustably checking the flow of the water.

RADIATOR SUPPORT.—A. L. W. OHMACHT, Cresco, Ia. An improvement is provided by this invention in supports for holding radiators in various positions so that any part of the radiator may be brought into position accessible for soldering and so that the hot solder will run into the desired place by gravity.

### Designs

DESIGN FOR A TONE ARM.—M. BORRIS, 2992 W. 31st St., Coney Island, N. Y.

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EVER since the turbine won its undisputed supremacy over the reciprocating engine in utilizing steam's force, the General Electric Company has been making turbines extensively for many uses.

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***No G-E Equipped Ship was ever Towed into Port Because of Turbine Trouble***

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**G-E RECORD**
**in U. S. Merchant Marine July 1, 1920**

| | |
|---|---|
| Units in service | 284 |
| Total H. P. Capacity | 691,600 |
| Miles traveled | 14,412,000 |
| Total dead weight tonnage | 2,555,829 |

Visit G-E Exhibit at National Marine Exposition, Coliseum, Chicago, October 18-23

General Electric Company

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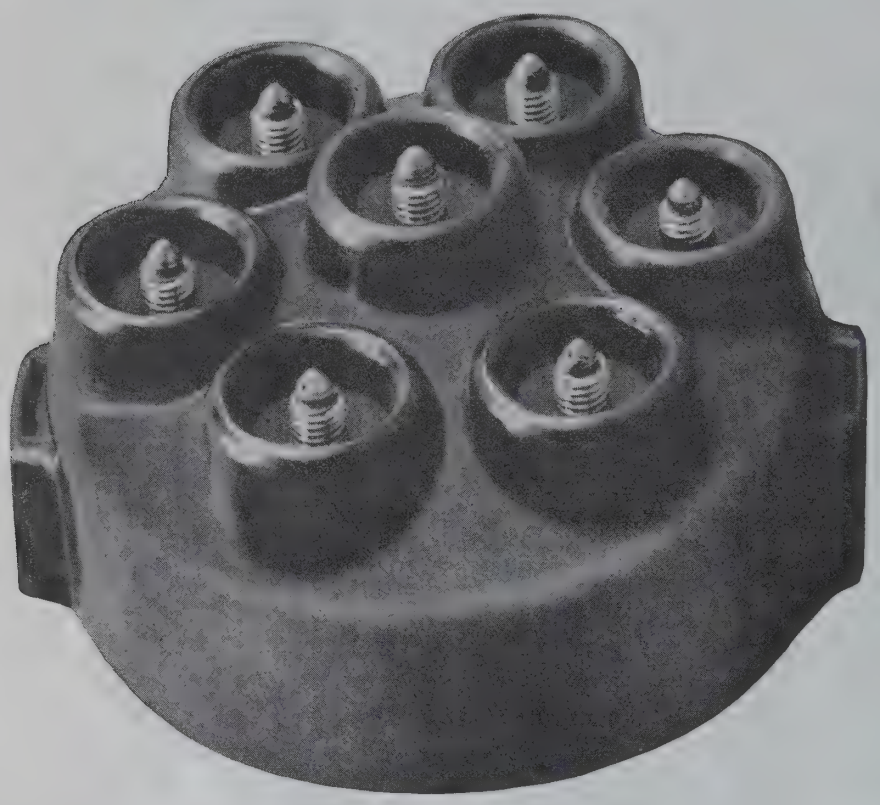

## You can trust it in your product

DAILY the list of REDMANOL users is extended to include more names of national repute. It seems, and rightly it should be so, that the higher the position a manufacturing institution holds, the more ready is it to embrace ideas and materials that mean product-betterment. It is difficult now to mention many lines whose leaders are not users of REDMANOL. The reason: it is the perfect molding compound. Its possibilities of use are limitless. Every day sees new additions. And in everything from ignition systems to bookkeeping machines to telephones to wireless outfits, and in an almost limitless number of other uses, it is ever reliable, always with the qualities listed below, never failing to do the part assigned to it. What is your problem?...bettered product? lessened production time? or lowered costs? Ask if REDMANOL can be used in your product.

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## Civil Engineering

*(Continued from page 326)*

who died in the war. The dimensions of this bridge are so great that it will be the largest single engineering work in steel ever built, or probably that ever will be built.

The suspension bridge, for structural reasons, is suitable for bridges of over 2,000 feet span, and for long-span bridges below 2,000 feet, the cantilever may be preferred. The two most notable examples of the cantilever are the two-track railway bridge over the Firth of Forth, whose two main spans measure 1,710 feet in the clear, and the Quebec Bridge across the St. Lawrence, with its main river span of 1,800 feet. Among the arch bridges, the longest single span is that built across the East River at Hell Gate, 1,017 feet between the abutments.

### Tunnels and Subways

Conspicuous in the review of the past seventy-five years of civil engineering are the vast works of tunneling which have been carried through as part of the work of providing urban and suburban communication. A first fruit of electrical facilities was the construction of the two main-line tunnels beneath the North River and the construction of electrified terminal stations in the heart of New York for the Pennsylvania and the New York Central Railroad systems. Then four tunnels known as the "Hudson Tubes" were built below the North River to give direct rapid transit from New Jersey to Manhattan. Another vast work was the construction of subways in Greater New York, which today have a total of over 600 miles of track in operation with a system of express trains running well above 40 miles an hour. The rapidity of sub-aqueous construction has been due to the use of the shield with pneumatic pressure.

### Foundation Work

The method of building deep foundations in loose and water-bearing material, contrary to the popular impression, has been long established. Smeaton, in 1778, sank the foundations for the bridge at Hexam, Northumberland, by the use of compressed air. As an alternative to that system we have the open cofferdam, a notable example of which was the construction by American engineers toward the close of the last century of the Hawkesbury Bridge in Australia. The closed caisson method has been invaluable in the construction of piers for bridges, and in the preparation of foundations for the modern skyscraper. Perhaps the most extensive use of the pneumatic caisson has occurred in this city, where the rock level is found at a depth of from a few feet to over 200 feet. With the introduction of the steel frame building the weight is concentrated at certain defined points over the area of the foundations and in building these, caissons are sunk to the solid rock and then filled with concrete to the appropriate level.

### Water Supply

Previous to 1845, the United States could boast of no city water supply of any magnitude, but about that period, the city of New York built a dam in the Croton watershed some thirty to forty miles from the city, and constructed also the old Croton aqueduct which brought the water from Croton Dam to service reservoirs in Central Park. Some fifty years later it was realized that the supply must be largely increased, and in the early 90's, a new dam and new aqueduct were built, and the new and old aqueducts together delivered about 385,000,000 gallons daily to the city. So great was the rate of increase in population of Greater New York that it became necessary to go much farther afield and bring in the mountain water of the Catskills. By the construction of the Olive Bridge Dam across the valley of the Esopus, the Ashokan reservoir with a capacity of 132 billion gallons was formed. This dam is 220 feet in height, and the water is led to New York City by an aqueduct from 14 to 17 feet in diameter which extends for a distance of 90 miles and in a deep tunnel is carried through the rock at a depth below the streets of Manhattan from 300 to 750 feet. Another notable water supply is that of the city of Los Angeles. The water is brought for a distance of 254 miles, partly in canal and partly in tunnel, and the daily supply to Los Angeles is 250,000,000 gallons.

Of all the great irrigation projects, the largest is that of the United States Government for reclaiming desert lands between the Mississippi and the Pacific Coast.

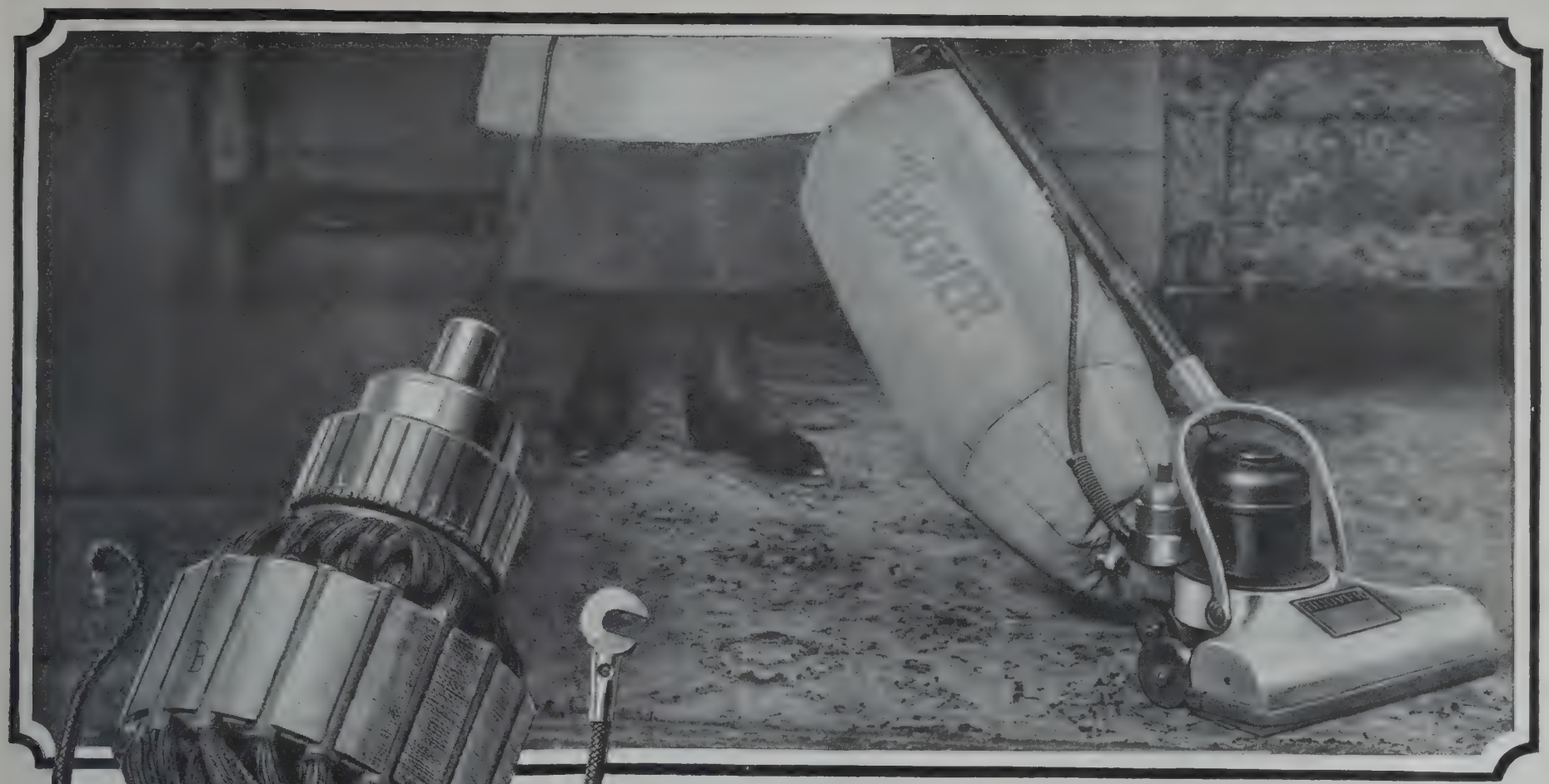
Among the many notable dams constructed for this work are the Roosevelt and the Shoshone dams, which are over 300 feet in height, and the Boise Canyon dam, 350 feet high. There are between 700 and 800 miles of canal, carrying from 300 to 800 cubic feet per second, and over 6,000 miles of smaller canals. Mention should be made here of another vast irrigation scheme made possible by the solid masonry of Aswan dam in Egypt, which extends for over a mile across the bed of the upper Nile River, and impounds 81,200,000 cubic feet of water.

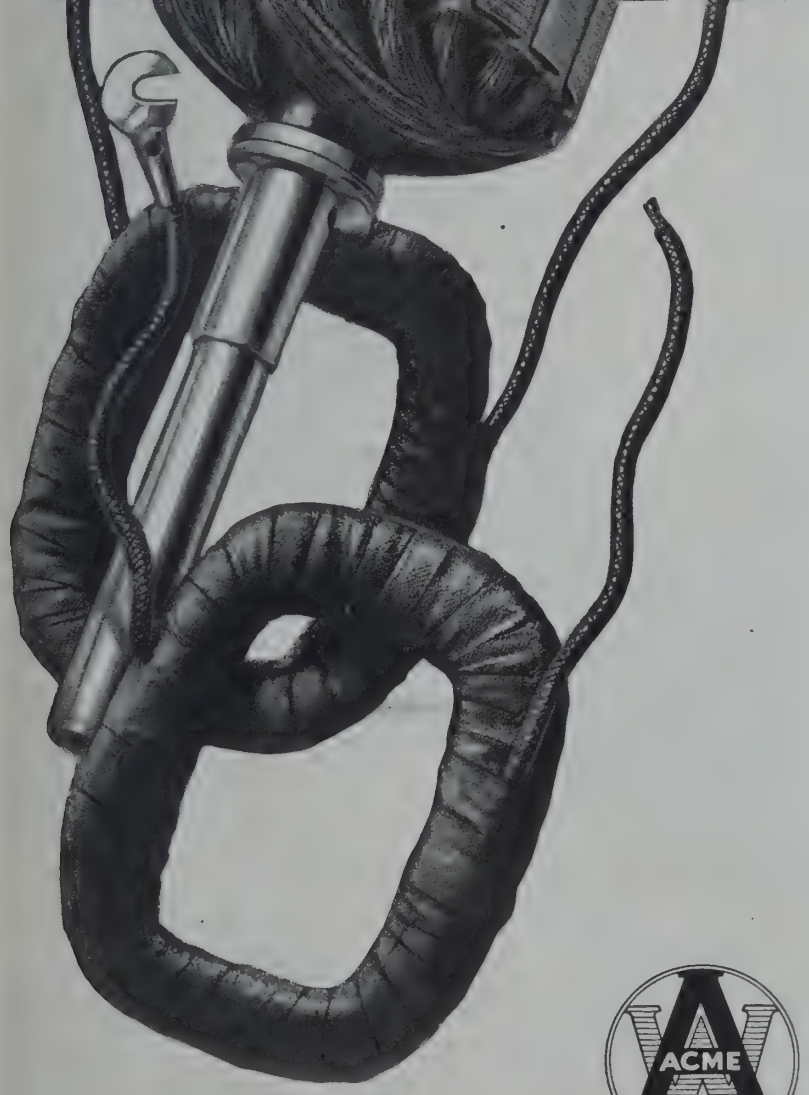
### Canal Construction

With the exception of road construction, the building of canals is the most ancient among the works of civil engineering, as witness the famous canals of Mesopotamia which rendered possible the flourishing civilization of the ancient races which dwelt in the valleys of the Tigris and the Euphrates. The greatest work of canal building in the United States during the past seventy-five years has been the continual enlargement and improvement of the Erie Canal connecting Lake Erie with the Hudson River by way of the Mohawk Valley. As opened in 1825, it had a maximum depth of only four feet; but improvements made between 1836 and 1862 involved the increasing of the depth to seven feet, and there has recently been completed a final reconstruction at a cost of over $150,000,000, which provides the canal with a minimum depth of twelve feet capable of taking barges of 1,000 tons.

Of the other notable canals built during the past seventy-five years are the Suez Canal connecting the Mediterranean with the Red Sea, which was completed by De Lesseps in 1869. Its original depth was 28 feet and subsequent work included the enlargement of the prism and the securing of a depth of 31 feet. The Kiel Canal between the mouth of the Elbe and the Baltic, a distance of sixty miles, was completed in 1895. There was completed by this country at the period of the opening of the great war the largest and most difficult work of canal construction in existence, namely the Panama Canal. It extends fifty miles from deep water to deep water, and it is remarkable for its great width and depth, the enormous amount of excavation involved and for the great difficulties encountered because of the climate and the unstable nature of the ground through which it was built. The problem of the turbulent Chagres River was solved by building a huge dam at Gatun and forming Gatun Lake with an area of 165 square miles. The dam is over 2,000 feet wide at its widest point. The depth of the canal is 45 feet. The locks have a width of 110 feet and a useable length of 1,000 feet.

The estimated cost of construction was greatly increased by the fact that what was supposed to be soft rock proved, on being cut and exposed to the water, to be a disintegrating material which flowed into the canal until it assumed a natural angle of repose of one to seven. The total cost is about $400,000,000.



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At least half of these electric parlor-maids have motors wound with Acme Magnet Wire—evidence of sure operation.

Where electricity comes into your life, as in vacuum cleaners, washing machines, doorbells, magnetos, self-starters, farm lighting outfits, for instance, Acme Magnet Wire and Acme Wire Coils give you the highest type of service.

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## Seventy-five Years' Growth of the Steam Railroad

(*Continued from page 330*)

railroad lines was equipped with block signals. In 1845, there was practically no block signalling in this country, and the Pennsylvania was the first road to make extensive use of the system, which it did in 1864. The Canadian Pacific adopted it in 1886, and thereafter it was gradually, but all too slowly applied to American railroads. Our great contribution to signalling was the introduction of the automatic signal, in which the train, by means of an electric circuit through the rails, operates its own signal and automatically safeguards itself. The first automatic signal was used in the universal track circuit installed on the Eastern railroad in Massachusetts, in 1871. Future development will be along the lines of what is known as the automatic stop, which consists in tying the signals in with the moving train so that if an engineer runs by a signal, the signal itself will automatically set the brakes and stop the train. A magnificent installation of this kind is that on the New York subway, where trains run at 40 miles under a headway of less than 1¾ minutes. So successful has this proved that something like a billion and a half passengers have been transported on the New York subways without the loss of a single life.

### Growth of the Steam Locomotive

The development of the locomotive has kept pace with, if indeed it has not been in advance of, the development of roadbed and general equipment. A typical locomotive of seventy-five years ago was a wood-burning engine weighing about eighteen tons and using the universal, Stephenson link motion. The earliest locomotives of this country were generally imported or were built along English lines; but very early the American locomotive began to develop its own peculiar characteristics. The rigid plate frame with inside cylinders, almost universally adopted in England where the roadbed was of more solid construction, was not found suitable to the more lightly constructed tracks of early American days. These tracks called for a special type of locomotive, having lateral and vertical flexibility. The lateral adjustment was obtained by means of the leading truck, and the vertical adjustment by means of equalizing levers. The weight is thus carried upon three points of support, one forward beneath the cylinders, and one on each side of the firebox. By this arrangement, the shock of any one wheel passing an obstruction is distributed and reduced before it reaches the main body of the engine. This combination made it possible to maintain high speeds over a track which would have ditched an English engine.

An engine of 1845 would have cylinders 15 by 20 inches, a weight of 20 tons, and drivers 4½ to 5 feet in diameter. Steam pressure was from 90 to 120 pounds. In 1848, the Baldwin Works built an express engine with cylinders 17¼ by 20 inches, and a pair of 6½ feet drivers; but she was considerably ahead of her time. That was a day of much experimentation. Single drivers of a diameter up to eight feet, were to be seen in service. A ten-wheel engine with six-coupled drivers was turned out by the Rogers Locomotive Company as far back as 1848. In the decade 1850-60, the coal-burning locomotive became common, and wood as fuel was gradually abandoned. About this time there came into use the wagon-top boiler, and the effect of anthracite coal was shown in the celebrated "camel backs" of the Ross Winans. The next deade, 1860-70, witnessed the introduction of the "Consolidation," the Bissel truck, and the swing-bolster truck. In 1870-90 there was a continual increase in the weight and power of locomotives, and they became classified into distinct types according to the work for which they were designed.

The compound engine was introduced into America in 1888, when the Pennsylvania Railroad purchased an English three-cylinder compound engine for trial. It proved to be highly economical, but it did not have sufficient power to haul the heavy passenger trains of the company's service. Compounding has been thoroughly tried out in this country with variable results. Today the tendency is toward the use of superheated steam in simple engines of large cylinder capacity. As showing the state of development of the passenger locomotive in the last decade of the previous century, we mention No. 999 of the New York Central system. This four-coupled express with 19 by 24-inch cylinders, 86½-inch drivers, 1930 square feet of heating surface and 190 pounds of steam pressure, hauled a 641-ton train from New York to Buffalo, a distance of 436.32 miles, at the rate of 64.22 miles an hour, exclusive of stops.

### The Era of High-Speed Travel

With the appearance of No. 999, there set in an era of high-speed passenger travel, which culminated in the first decade of the present century when the New York Central Railroad placed in service a train which made the trip from New York to Chicago in eighteen hours—a challenge which was promptly answered by the Pennsylvania Railroad. Since that time, in response to a demand for safety and for reasons of economy, the running time of these trains has been cut down, and it is not likely that any such speed schedules will be attempted in this country for many years to come, not at least until electrification has become general.

So far as locomotive design is concerned, the effort of the past two decades, and especially of the last ten years, has been to increase power so as to increase the capacity of the trains whether in freight or passenger service. The standard, heavy, express passenger locomotive of today has six coupled-drivers with a leading four-wheel truck and a pair of trailers beneath the cab; and the most powerful of these wonderful machines is capable of hauling a twelve to fourteen-car Pullman train weighing from 900 to 1,000 tons at the rate of sixty miles an hour on level tracks. An even greater increase in size and power has taken place in the freight locomotive, and we illustrate a well-known locomotive, the "Virginian," which was built by the American Locomotive Company for service on a stretch of fourteen miles of track which has a ruling grade of 2.07 per cent. This engine, the most powerful steam locomotive in existence has cylinders 30-inch diameter high pressure and 48-inch diameter low pressure by 32-inch stroke. The boiler has an internal diameter of 8 feet 7⅛ inches. The total heating surface, including superheater, is 10,725 square feet, and the tractive power when the engine is working the compound is 147,200 pounds; when working simple, it is 176,600 pounds.

### Introduction of Electric Traction

It was inevitable, in view of the success of the electric trolley, that electric traction should be applied to steam railroads. The first installation was for hauling trains through the belt line tunnel of the Baltimore & Ohio Railroad at Baltimore. This was followed by the very ambitious electrification of the terminal lines of the New York Central and the New York, New Haven and Hartford Railroads in New York City. This terminal zone, as it is called, extends 30 miles out on the main line of the New York Central to Croton, and some 75 miles to New Haven on the New Haven line. In the interval since that great work was decided upon, improvements in the art of electric traction have been such that it is now possible to utilize the direct-current system economically over continuous stretches of

(*Continued on page 354*)

# Mo-lyb-den-um Steel

## *The American Super-Steel*

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## The LIGHT WEIGHT CAR

THROUGH the ages, man's progress in the development of transportation has been dependent upon the discovery of better materials with which to put his ideas into execution.

The modern motor car is a product of steel. And so it cannot be better than the steel from which it is made.

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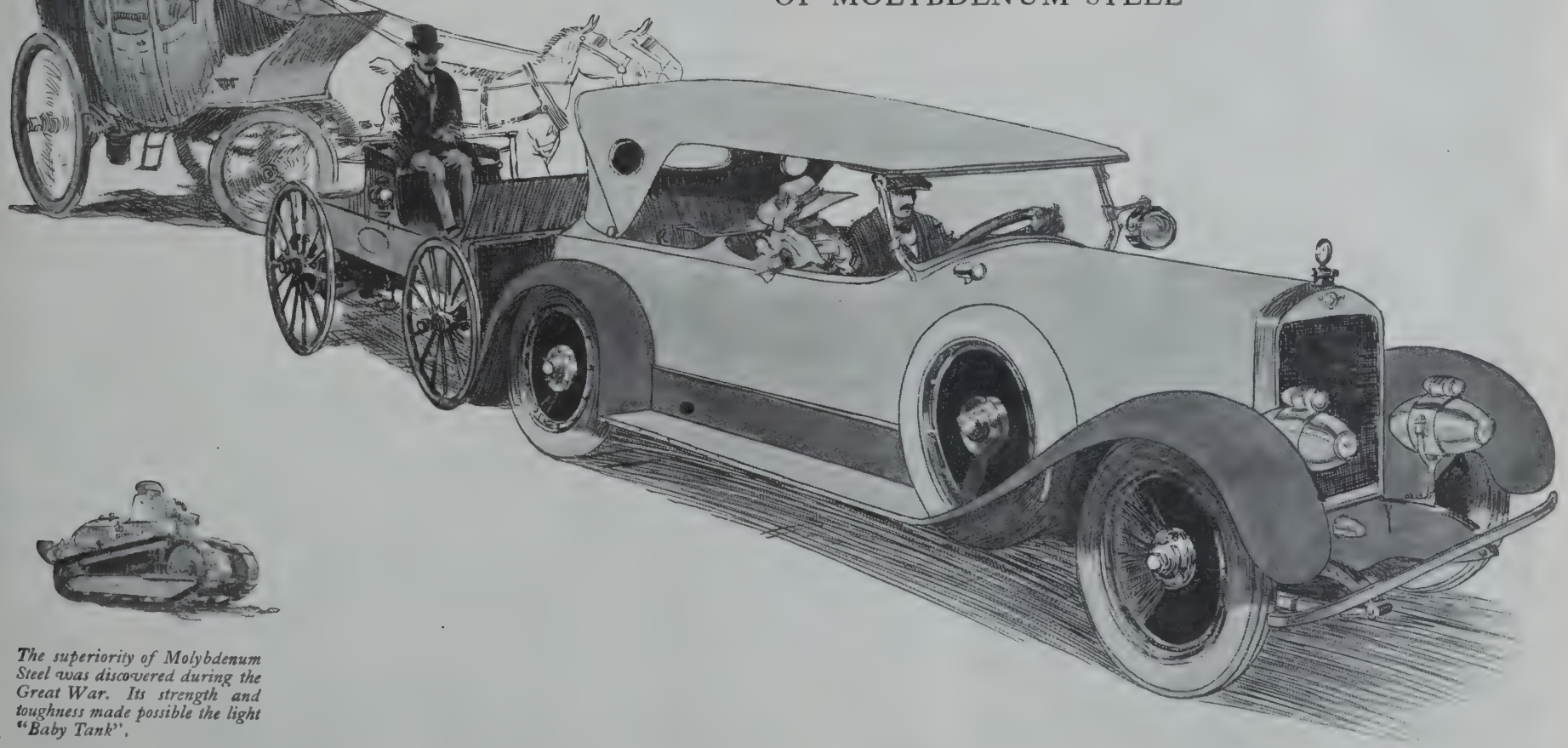



*The superiority of Molybdenum Steel was discovered during the Great War. Its strength and toughness made possible the light "Baby Tank".*

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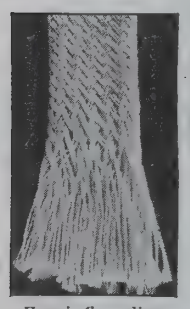
# Protecting the Insulation

THE real mechanical strength of any portable electric cord is in the *outside covering*. Once this covering wears through, the insulation is an easy prey to hard knocks, abrasion, oil, moisture, heat and even light—for light tends to make rubber brittle.

Duracord has a thick, heavy fabric cover *woven* like a piece of fire hose instead of the usual light braid. That's why it outwears ordinary cords 4 to 6 times. It has unusual strength where the wear comes—on the outside.

Duracord can be furnished in all sizes of portable electric cord and also in the larger sizes of single and duplex cable. Ask your electrical jobber about Duracord or let us send you samples of Duracord and ordinary cord for you to test and compare yourself.

*This is Duracord. Thick, heavy strands, woven like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.*



*Here is the ordinary braided cable covering. Note the open and porous construction, easily cut, stretched or unraveled. Compare it with the illustration of Duracord above.*

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**Pawtucket, R. I.**

*Makers of Duraduct*
*Flexible Non-Metallic Conduit*
*and tubular woven fabrics of all kinds*

**DURACORD**
TRADE MARK REGISTERED


## Seventy-five Years' Growth of the Steam Railroad

(*Continued from page 352*)

line, that could not have been economically operated ten to fifteen years before. The most famous installation is that made by the Chicago, Milwaukee and St. Paul Railroad for the operation of its mountain division; and for this purpose several exceedingly powerful passenger locomotives exceeding in their hauling power any previous locomotive, whether steam or electric, are in operation on that division. We illustrate one of these which has an over all length of about ninety feet. There are twelve 68-inch drivers, driven through gears by six electric motors, which develop a total of 4,200 horsepower for one hour and a normal starting drawbar pull of 100,000 pounds. The total weight of the locomotive is 275 tons, and it is capable of hauling the heaviest all-steel Pullman trains at a speed of 30 miles an hour on the steep mountain grades. It now seems to be only a question of time when we shall see a practically universal application of electric traction on the railroad systems of the United States. Based on data gathered by the Chicago, Milwaukee and St. Paul Railroad from its electrified mountain division, the fuel economy resulting from electric traction would represent a saving, annually in coal consumption of 122,500,000 tons of coal—that is to say, over two-thirds of the coal burned in the steam engines of our railroad system would have been saved during the year 1918, had the railways been completely electrified along the lines which today have been fully tried out and proved to be successful.

## Seventy-Five Years of Applied Electricity

(*Continued from page 333*)

his laboratory grounds were illuminated by seven hundred lamps, took place late in December, 1879, and attracted prominent visitors from all over the country.

Development during the years 1880 to 1889 was rapid and important. Lamp costs were brought down, as simplified methods of manufacture were introduced. The price of arc light carbons was gradually reduced from $240 per thousand to about $10 per thousand. The art of "pasting" carbon filaments to the lead wires was discovered; previously, the filaments had to be attached by expensive mechanical devices, such as tiny bolts, nuts, washers, sleeves and clamps.

By 1890 electric lighting was beginning to be common in every civilized country. In 1891 the cellulose or "squirt" process of making carbon filaments was commercially introduced. Two years later the cellulose filament generally supplanted the carbonized bamboo. In 1895 came the "chemical exhaust" for incandescent lamps, which improved their average quality, at the same time reducing their cost. Indeed, the cost was reduced from 32½ to 20 cents each by 1895.

In 1892 the substitution of molded bulbs for "free-blown" bulbs proved another step forward. Phelps, in 1898, invented the turn-down lamp. In 1898 Dr. Welsbach, of gas-mantle fame, produced his first osmium filament lamp, although metallic filaments came into general use many years later. The mercury arc lamp was originated by Arons in 1892, and later developed to a point of greater commercial practicality by Cooper Hewitt.

The invention of the enclosed arc lamp in a practical form was announced at an electrical convention in 1894, when L. B. Marks described the first enclosed arc lamp embodying the points that made it, for a period of ten years, the favorite unit for high candle-power lighting in America. In 1899 the Bremer flame arc was announced, and in the following year Bremer exhibited at the Paris Exposition a model having four impregnated carbons, so arranged that the light produced was thrown downwards. Other forms of luminous arcs followed, with various combinations of salts for producing various kinds of light.

The discovery of ductile tantalum came from a German laboratory in 1901, and the first experimentally successful tantalum lamp was constructed a year later, although several years more had to elapse before this form of lamp was ready for commercial exploitation.

In 1905 the "metallized" carbon lamp, in connection with which notable work was done by J. W. Howell, made its appearance and served as a sort of stepping-stone to the lamps of still higher efficiency that were about to make their appearance.

In 1907 came the pressed-filament tungsten lamp, for which we are indebted in great measure to two European inventors, Just and Hanaman. This lamp, in the hands of such men as Dr. W. D. Coolidge, Dr. A. Pacz, and a host of other experts, has gradually evolved into a strong, durable, cheap, drawn-wire lamp.

Within the past few years the gas-filled tungsten lamp has come to replace the vacuum lamp of the recent past. Indeed, at first these gas-filled lamps, generally using nitrogen, and in some instances argon, were available only in candlepowers running in the hundreds and even thousands. But during the past year or two the gas-filled lamp has been developed so that it is available in sizes as low as 50 watts, thus making it an all-round lamp.

### From Morse's Telegraph to Bell's Telephone

That historic telegraph message, "What hath God wrought!" sent in dot and dash over a telegraph line from the Capitol, at Washington, to Mount Claire Depot, in Baltimore, dates back to May 24th, 1844, one year before the initial appearance of the SCIENTIFIC AMERICAN. The message was indited by Miss Ellsworth, the daughter of the then Commissioner of Patents, and was intended to express the wonder of the achievement of the telegraph.

It was Samuel F. B. Morse who gave us the telegraph. As in the case of many other electrical machines and devices, we find many experimenters and investigators at work on the idea of communicating over wires by means of electric currents long before Morse's successful attempt; but the fact remains that Morse, like Marconi more than fifty years later, had to assemble numerous ideas together and work out the successful commercial telegraph. Hence Morse is the inventor of the telegraph.

Morse's original telegraph provided a pendulum carrying a pencil or marking device in constant contact wth a strip of paper that was drawn beneath the point by a gravity-operated movement. As long as no current came over the line, this arrangement would make a straight line upon the paper. The pendulum carried also an armature, and the electro-magnet was placed near the armature. A current passed through the electro-magnet would draw the pendulum to one side. On being released the pendulum would return, and in this way any amount of zigzag marks could be made on the paper as it traveled with the pencil constantly pressing upon it. Vail, an associate of Morse, made some changes in this device and substituted for the pendulum and marking pencil the familiar lever with pencil of a more recent type of Morse register, and substituted for the zigzag line the dot and dash system of telegraphy.

The telegraph is one device which has become simpler through perfection. As Morse conceived it, the telegraph was formidably complicated. For one thing, Morse wanted a recording device; he did not realize that men could be trained to read the signals by sound. Then he had trouble finding some suitable method of making the dot and dash signals at the sending end. For this purpose he used metallic type with indented faces so shaped as to open and close the circuit at

(*Continued on page 356*)

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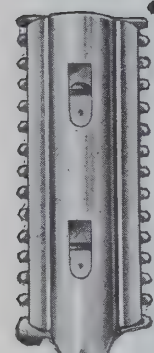
*An independent company that produces and refines its own petroleum*

# Some Blade!

DURHAM-DUPLEX

*A Real Razor-made Safe*



You "hop to it" with a smile, and finish up the same way, when the Durham-Duplex is on the job. Good-bye to scraping and "pulling". Good-bye to face-burning and skin irritation.

The famous two-edged, detachable Durham-Duplex Blades are the longest, strongest, keenest blades on earth, oil-tempered, hollow-ground and scientifically stropped to an edge of surpassing sharpness—and guarded to prevent cutting.

It's the greatest blade ever. You'll say so yourself after a single shave with this real razor.

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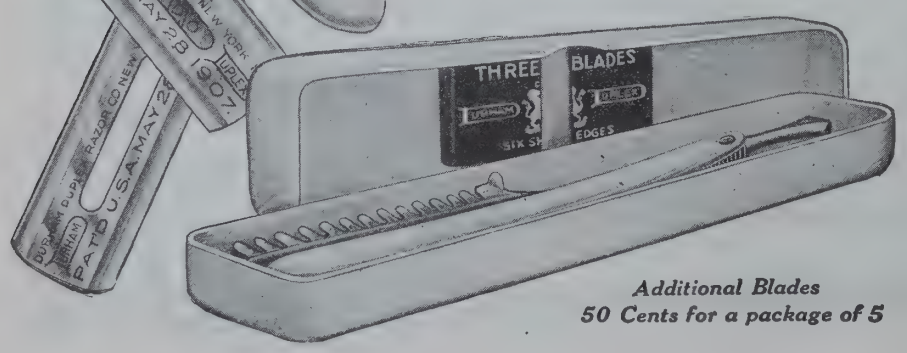


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*50 Cents for a package of 5*


## Seventy-Five Years of Applied Electricity

(*Continued from page 354*)

proper times and for proper periods. Each letter constituted a separate type, which was mounted on a portrule. When this was filled with type representing the message, it was drawn under the contact point. Then, as a simplification of this, two contact points close together were used, between which a wedge was thrust by hand so as to open and close the circuit. Again, a keyboard like a piano, with each key for one given character, was tried out and abandoned. But by 1844 Morse introduced the plain key very similar to that in general use today.

By 1855 the telegraph had become a commercial proposition of no mean proportions. A straggling web of lines under the control of thirty or forty rival companies, worked with different apparatus under different patents, covering the most populous area of the country.

Little had been done in the way of improvement. Indeed, the telegraph seemed about as efficient as could be wished for in view of the traffic requirements of those days. Operators here and there had begun to read signals by the sound of the marking lever. Morse was violently opposed to this practice, and insisted on the use of the tape. However, his collaborator, Vail, finally yielded to the operators' new method of reading signals, and by the simple suppression of parts, the well-known sounder came into being.

Some fifteen years later telegraph advanced still another step, namely, the duplex telegraph, enabling two messages to be transmitted at one time in either direction. The chief workers in this field were Gintl, Frischen, Siemens and Halske, Preece, Farmer, Nystrom, Maron, Winter, Stearns, and Muirhead.

Next came the quadruplex telegraph, with four messages sent simultaneously over one line. This seems to have been first proposed by Stark of Vienna in 1855, and subsequently worked at by Bosscha, Kramer, Mason, Schaak, and others. But the first to obtain satisfactory results was Edison, who invented his method in 1874.

From the land the telegraph passed to submarine cables, and many new problems arose which had first to be solved before commercial success became possible. The credit for having completely overcome these difficulties is mainly due to Dr. Muirhead of London. The experiments on short lengths in the English Channel and elsewhere fascinated American and British business men with the idea of a transatlantic cable, and it remained for Cyrus W. Field, who possessed unbounded persistence in his work, to lay the first transatlantic cable in 1866. With the aid of the "Great Eastern" a submarine cable was laid between Valencia, Ireland, and Trinity Bay, Newfoundland, in less than a month's time. The service was subsequently interrupted and repaired, but that is a matter of general history and of common knowledge.

The long cable brought out the fact that more sensitive instruments were required. Thomson, later Lord Kelvin, overcame the difficulty by inventing the mirror galvanoscopic receiver and later his siphon recorder. Other improvements followed.

Printing telegraphs, such as the stock quotation tickers, and high-speed telegraphs figure throughout the career of the telegraph, but space does not allow of touching upon these phases.

Like the telegraph, the telephone was suggested by various experimenters in an indefinite sort of a way, but it remained for the genius of Alexander Graham Bell to give the world the commercial telephone system. For instance, in 1861 Philip Reis of Friedrichsdorf disclosed in a lecture an instrument which he called a telephone, for the production at a distance of music and human speech. Perhaps Reis's telephone never talked, but it did transmit musical sounds. It was not until 1876 that Bell produced the first telephone which could transmit speech. Bell's patent has been called "the most valuable single patent ever issued." The early development of Bell's telephone was also due to Edison, Gray, Dolbear, Berliner, Blake, Hughes, and others. In 1877 Berliner invented the loose-contact transmitter and applied the induction coil between transmitter and receiver. These two inventions have been retained to this day.

Such men as Carty, Scribner, and Dean have brought the telephone to its present perfection. The one man who did most to create the switchboard is Charles E. Scribner. Prof. M. I. Pupin invented the loading coil in 1899, in order to obviate the bad effects of capacity on long-distance lines by increasing the self-induction. His invention made long-distance telephony practicable.

Within recent times we have the automatic telephone, which now threatens to supplant the usual manually-operated system because of the increasing difficulties in the way of maintaining a large personnel.

Another phase of communication is the telautograph, but so involved is the development of this method from the early efforts to the present perfected systems that nothing further can be said here. The same applies to the various systems of transmitting photographs and drawings over wires.

### Marconi's Contribution to Communication

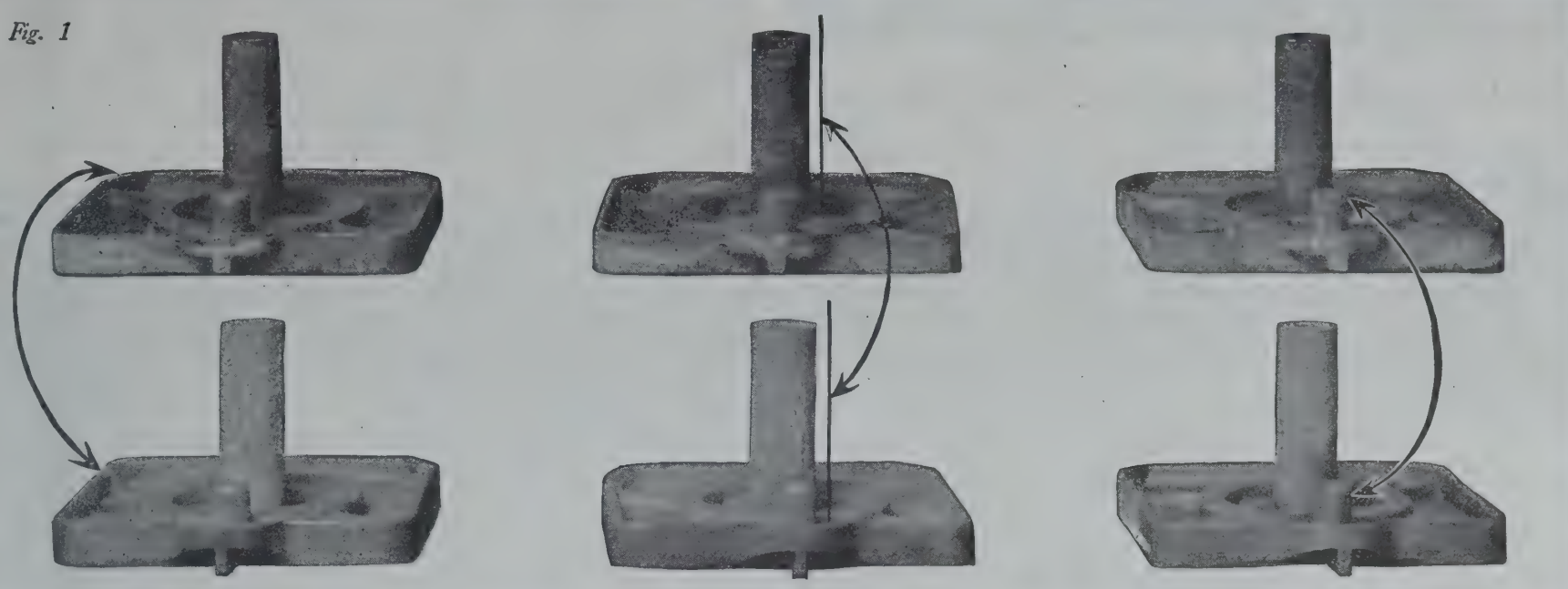
Again it is the old story of numerous attempts culminating in the work of one man capable of developing a commercially promising system; this time Marconi's story—and wireless. We must necessarily skip over the efforts of Hertz, Branly, Popoff, Lodge, and others and come right down to 1895 when Marconi, as a young man, was conducting experiments on his father's estate at Bologna, Italy. From a few hundred feet separating his transmitting and receiving equipments, Marconi soon increased the distance to over a mile. The apparatus was constantly being developed, and larger aerials and more power were being employed at the transmitting end. The distance covered rose to 100 miles, several hundred miles, and finally Marconi was ready for a transatlantic attempt. On December 12th, 1901, Marconi succeeded in transmitting repetitions of the letter "S" across the Atlantic from Poldhu, in Cornwall, to St. John's, Newfoundland.

Marconi was by no means alone in the development of wireless communication. In fact, many valuable contributions to the art came from many other inventors, and it is well to mention Fessenden, Fleming, Shoemaker, Lee de Forest, Braun, Poulsen, Ferrie and Wein. Wireless rapidly developed, and late in 1907 Marconi opened a restricted public radio service between Glace Bay, Nova Scotia, and Clifden, Ireland, thus going into direct commercial competition with the Canadian cables for the first time. Less than a year later the Glace Bay service was offered to all classes of telegraph traffic.

Since the war wireless has met with a remarkable development, due in large measure to the urgent necessity for all possible methods of communication. The transatlantic stations at Tuckerton, N. J., and Hanover, Germany, were put into communication as early as 1914, using the ingenious system of Goldschmidt. During the period of the war we find more and more wireless systems turning to the vacuum tube for receiving, amplifying, modulating and transmitting purposes. Indeed, this simple device—little more than an incandescent lamp with additional electrodes inserted in the vacuum—may be said to have solved practical wireless telegraphy and wireless telephony. Originally suggested by Edison's experiments, introduced in wireless communication by

(*Continued on page 358*)

*Fig. 1*



# Lower costs attained by elimination of unnecessary machining

NO detail of machine-shop work holds the eye of the inexperienced visitor more absorbingly than the spectacle of a machine as it gouges off deep bites of metal from a casting. Compute the cost of the machinist's time, lump in the proper overhead for the machine and floor-space, and then add the cost of waste metal and it becomes quickly apparent how expensive a form of entertainment this can be.

*Every unnecessary cut is pure waste.*

It represents a mistake in the selection of castings.

On this page are shown in photograph and diagram exact reproductions of castings taken from actual practice which illustrates the waste resulting from inferior castings.

The upper row in the photographic illustration above (see Fig. 1) shows a series of castings produced by machine moulding. Below is the same casting in series as made from hand-made moulds. Even in reduced reproduction the contrast between the non-uniform hand-made casting and the uniformly regular machine-made casting is easily apparent. (No effort was made to make a favorable selection of the machine-made castings.)

As the lower group of castings came to the machine shop for layout, each casting was a separate problem to the layout man. He was compelled to locate holes off center on bosses—and do many other undesirable things to make his principal cuts come uniform—or at all. Contrast this with the upper group of castings—"as like as peas in a pod"—the layout man's difficulties disappeared—repetition makes fast work easy.

Furthermore, in the case of the hand-made casting the shell of pad metal not only bulks greater but its thickness varies greatly. So great is this variation that frequently such castings, although they appear to the eye as O. K., are dangerously near being defective because there is no margin of metal between the surface of the rough casting and the specified dimension of the finished surface. When "hollows" penetrate even $\frac{1}{32}$" too deep, no choice then remains except to scrap the casting and charge to "Expense" the labor performed on it before the discovery.

The irregularity of the hand-made casting, when compared with the even, uniformly shallow depth of waste metal on the machine-moulded casting, makes clear at a glance the greater rapidity and uniformity possible in machining the latter.

Machine-moulding in the best machines can be accurately controlled within $\frac{1}{16}$ inch per inch of pattern draw. This degree of accuracy, backed by the fact that the machine-made mould is free from non-porous spots caused by hand-patching and slicking, insures the remarkable uniformity here pictured.

Based on this uniformity (and impossible without it), wholesale economies can be effected in machine-shop practice where large scale production is the goal. *First* comes the sweeping economy in layout time where one laying-out of a job serves as the only basis required for repetition day after day of the same cuts on castings which are themselves uniform. *Second* comes the saving in cutting time, due to reducing the shell of waste metal to a minimum. Compute the saving of only a single cut less across each face of a casting and then multiply it by the number of castings handled per day and you gain a partial

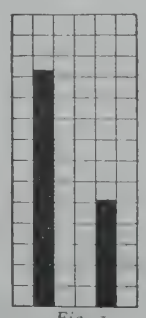


*Fig. 2*

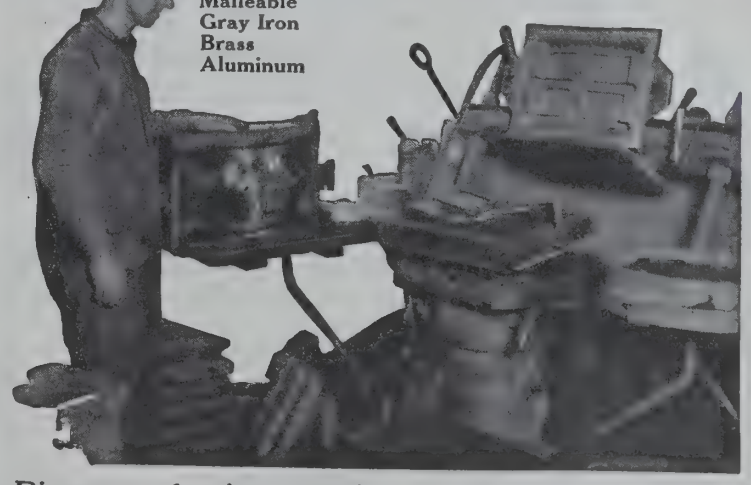
*Figure shows an average of comparative costs furnished by scores of machine shops before and after the adoption of machine-made castings.*

picture of the resulting yearly economy. The *third* economy results from the closely-held accuracy of the machine-made casting which virtually eliminates defective castings, and cancels the previous losses due to waste machining on defective castings—a decrease of 71% in defectives is the average result of the change to machine-made castings.

The sum of all these economies is graphically illustrated in Figure 2 which shows how the machining costs dropped in a large group of shops which adopted the machine-made casting.


BETTER CASTINGS

Steel
Malleable
Gray Iron
Brass
Aluminum



Bigger production would not justify machine-moulding if the castings were not unquestionably superior.

Osborn machine-molding turns out more castings in the same working-space, reduces or eliminates the loss in defective castings, reduces waste metal, reduces or eliminates chipping, scraping, stoning and filing, and assures satisfied customers.

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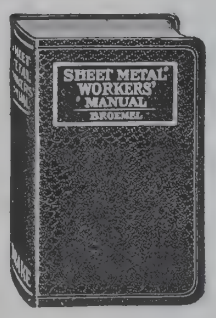


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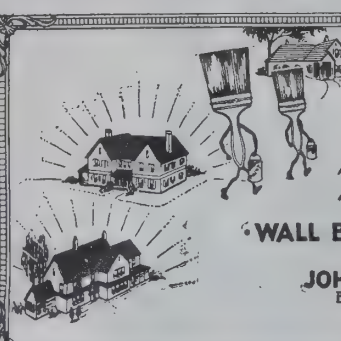

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CARBURETOR


## Seventy-Five Years of Applied Electricity

(*Continued from page 356*)

Fleming, and developed to a high state of perfection by Dr. Lee de Forest, the vacuum tube constitutes the greatest step forward in the art since Marconi's first experiments. The vacuum tube, in its multitudinous sizes and designs, permits doing things hitherto deemed impossible.

The wireless telephone is a natural growth of the wireless telegraph. At first the electric arc was employed as the generator of high-frequency currents for radio-telephone purposes; but with the development of the vacuum tube the arc has lost its place in radio telephony except when it is a question of tremendous power. Even then, there are high frequency alternators, such as the marvellous machine of Alexanderson, which lend themselves to radio telephony. Such names as Poulsen, Fessenden, Colin, Jeance, de Forest, Arco and Majorana figure in the development of the radio telephone.

Nineteen hundred and twenty—and we have attained what appears to be perfection in wireless communication. We have numerous stations capable of transmitting and receiving signals over thousands of miles. The atmospheric disturbances have been largely ameliorated, and even now there are certain antistatic systems which promise to render wireless systems as immune from such disturbances as the underground telephone cable. It is a great step, to be sure, from Marconi's crude set of 1895 to the 12,500-mile Lafayette radio station at Bordeaux, France, constructed by the United States Navy during the war so that we might never be out of touch with our men "over there."

## The Rise of the Automobile

(*Continued from page 335*)

still run by single-cylindered engines; the Haynes-Apperson, Winton, Stearns, Oldsmobile, Stevens-Duryea, Arrow and Peerless employed two cylinders; the Gasmobile boasted one of the earliest fours. For the next year the Locomobile came on the market in two- and four-cylinder models and the Franklin appeared as a four, while the Peerless added a four to its line; current opinion would doubtless have named two cylinders as standard practice for the ordinary car, and four as desirable in the big fellows. By 1905 the four-cylinder standard was well established. In 1907 the first six-cylinder model appeared in England, the work of Napier, and the precedent was quickly followed, until by, say, 1910, it might have been said that the two-cylinder car of 1902 had become a four, and the four a six. At the same time Hewitt produced an eight, but this precedent was ignored for nearly a decade; the earliest of the existing eights appears to be the Cadillac, of 1914. The tendency toward sixes, and later eights, continued; and finally, in 1915, the Packard, almost the last car to give up the single cylinder, was the first to set the mark at twelve.

A change of importance that ought to be mentioned is that from chain drive, universal in the early models, to the propeller shaft with bevel gears. If a date were to be set at which this became first effective, it would be somewhere in the vicinity of 1905.

The early designers surrounded the single cylinder with a water jacket, but made no definite provision for water economy. Perhaps they did not expect their cars to run far enough, on one stretch, to require fresh water. But by 1900 the cruising radius had gone up, and radiators recognizable as such made their appearance, though as late as 1902 they were universally low with sloping fronts. The higher, vertically up-standing type appeared in 1904-05, and swept the field clean within two years at the most. Circulation was by pump, until the Renault designers incorporated the thermo-siphon, which spread to a few other models after 1907. But it must be emphasized that air-cooling is not a recent development; the Franklin, which would be the Wilkinson if named after its creator, dates back continuously to 1902-03, and the Knox and Marmon, among others, were air-cooled for a time.

The dividing line between horseless carriage and automobile may perhaps be drawn from the point where the motor was transferred to the front and the conservative upright steering post with horizontal rod replaced by the more sporty wheel. Among the names that lived, the Knox, Duryea, Haynes, Oldsmobile, Stearns and Pierce were all handled through rods in 1902; the vogue of the wheel appears to have become definitely established not earlier than 1904. And Levassor's example in putting the engine where it belongs was still defied in 1902 by the Stearns, Pierce, Packard, Oldsmobile and others, but had become universal two years later. So perhaps we might say that the period before 1900 was that of the horseless carriage, and that after four years of transition we come to the automobile.

### A Problem in Prosperity

It seems amusing to us, today, to turn back to 1910-12 and read that the vast increase in the use of the automobile had caused such a demand for gasoline that the quality had gone down to a point that constituted a problem. We will understand this better if we realize that the cars of 1900 and 1905, burning the high-grade gasoline then on the market, were expected to start, under all conditions and without priming, on a half or even a quarter turn of the crank. When the fuel became of such sort that this was not feasible, there was a universal consensus that some sort of starting motor would have to be devised. A great many sorts were put forward, but those that worked pneumatically or through springs or by introducing a preliminary charge of acetylene or some other violent explosive and touching it off with the spark went overboard when it was shown clearly that a wet battery could be built that would not be damaged by such roughing as it would get from riding in a car, and that a generator could be installed that would keep it charged to the necessary voltage for starting. The development of the electric starter began in 1910, and by 1913 was complete, all the better cars being by that time so equipped. But if a battery must be carried for this purpose, economy demands that it be used also for lighting and ignition, relieving the car of weight and installation expense represented by oil lamps and magneto. So we find at this time the very general reversion to battery ignition, referred to above. The magneto, however, has not submitted tamely to this. Admitting that at the slow engine-speeds of cranking, whether manually or by motor, the battery gives a better spark than the magneto, the advocates of the latter point out that its spark increases in intensity with engine speed and that it ought therefore to be better after the car gets under way. Opinion here is still in a point of flux; and it is difficult to say whether the present vogue of dual ignition represents really an effort to get the best of both systems, or merely a desire to sidestep the question of choosing between them.

### From Sport to Utility

In the beginning automobile design and operation was a recreation, a means of riding a hobby and at the same time gratifying the mechanical instinct that impels men to play with motor boats and wireless and such things. A man built a horseless carriage and drove it about the roads of his home town, not so much from the desire to achieve transportation

(*Continued on page 360*)

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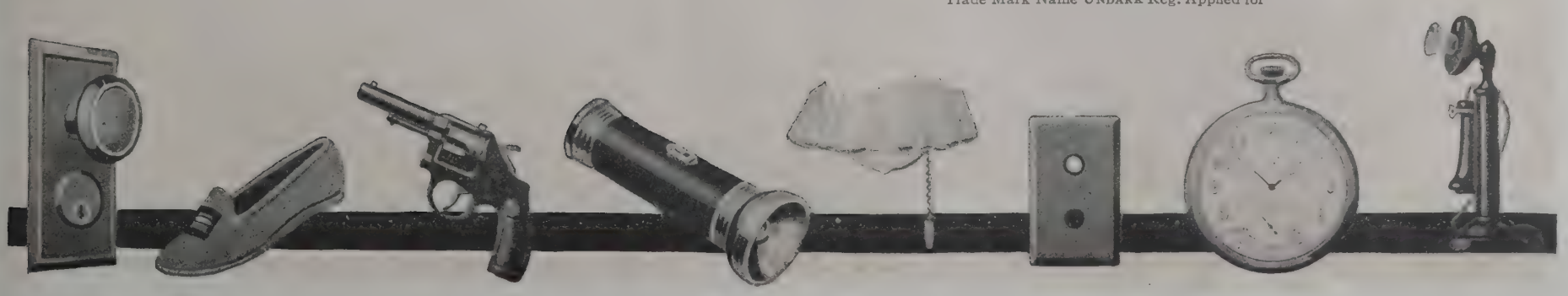

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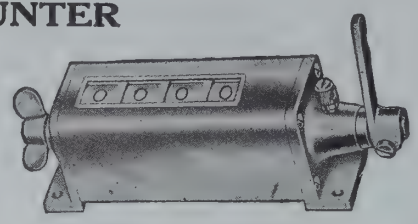

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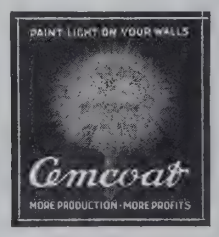


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## The Rise of the Automobile

(*Continued from page 358*)

as to satisfy the inventive impulse in a wide-open field. When the experience of the pioneers had crystallized to a point which gave the driver of such a vehicle a sporting chance of getting it home again the same day, a market appeared for its sale to men who were willing to drive it but unable or unwilling to build it. On this basis the new industry had its beginnings; men like Haynes and Duryea and Olds in America, Panhard and Levassor in France, found that they could sell their machines to others, and immediately made it their business to do so.

The end of this experimental period might be set somewhere around 1899. It was here that the name "automobile" began to drift in from France, while self-propelled vehicles were seen in our streets with sufficient frequency to make it worth the small boy's while to coin the standard jibe, "Get a horse!" with which to greet them. The decade from 1898 to 1908, perhaps a bit shortened at each end, might fairly be called that of the automobile's adolescence—the period during which, like adolescent humans, it was always on the *qui vive* to show what it could do. In real, practical utility there was little advance over the preceding five years; but the automobile was so much faster and so much more reliable that real racing, on road and on track, was now profitable, and became characteristic of the epoch.

With due allowance for the extremes to which it was carried, this was a necessary stage in automotive developments, and one which led swiftly and surely to better machines. For if the race is to the fastest, it is equally to the contestant who is able to keep going. And when its racing performance had sufficiently demonstrated the automobile's ability to keep going, there were plenty of hard-headed gentlemen of finance to inquire whether there was not something useful that could be done with it. In answering this question in the affirmative the automobile industry passed into its third and present stage, that of wide commercial development as a recognized utility.

With the quest of utility, however, the designer must fact a brand new problem—that of building cars of diverse types for diverse special purposes. One angle of this problem is seen in the divergence of passenger cars. This multiplicity of types is a feature of the present-day automobile whose relative newness often escapes us.

Another thing that happens when the designer begins to consider the purpose for which his product will be used is the great divide between car and truck. So far as any published figures show, the first machines built in the United States for strictly and admittedly commercial use and under a separate classification were of date 1904. The beginning was small enough, only 411 trucks for the year; but these were really trucks, with frames and axles built for heavy loads and with power plant and transmission designed for the peculiar demands of hauling merchandise.

### Truck and Tractor

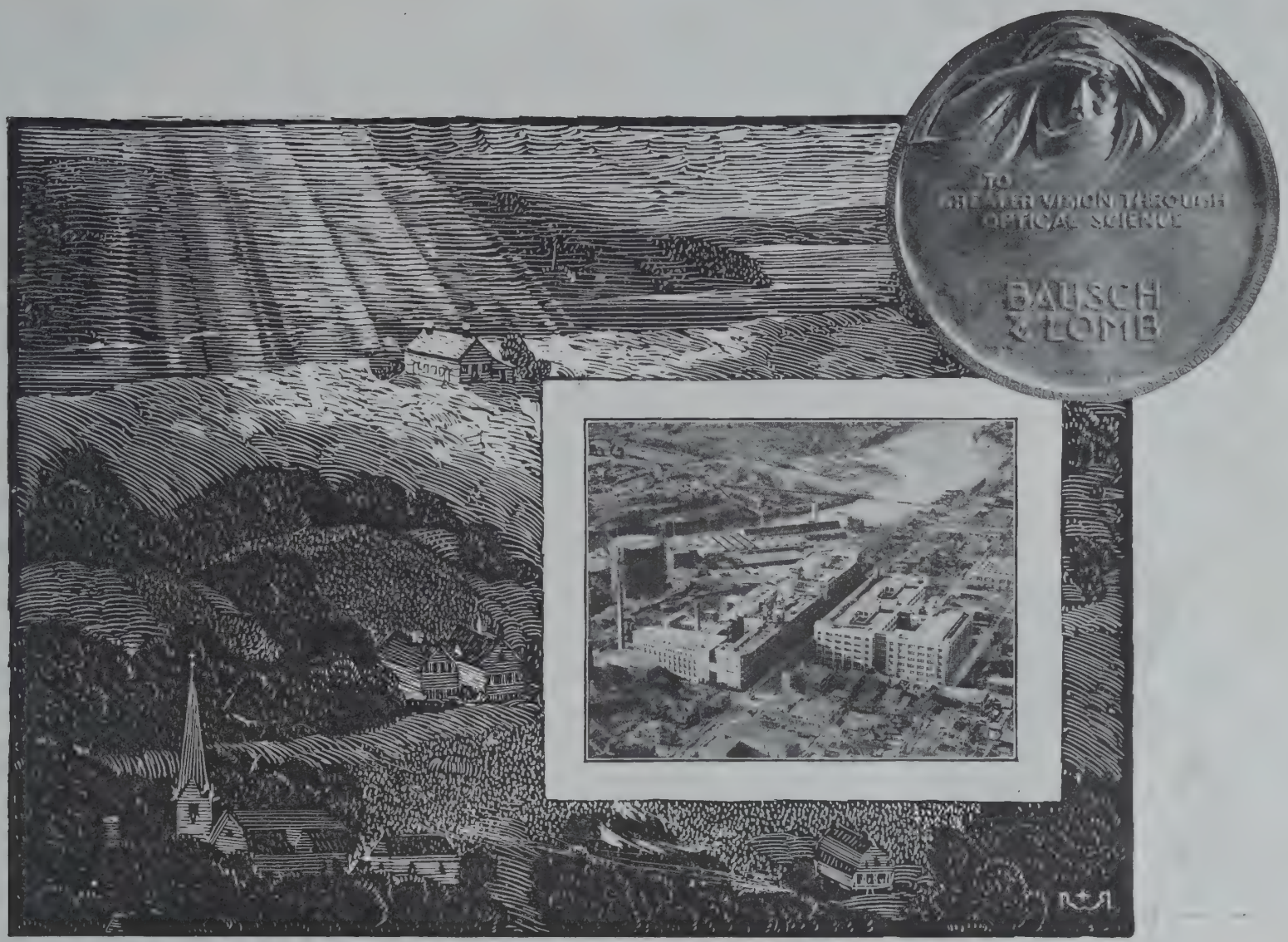
The trend of truck development is too technical to follow in detail, but we may note the major points of departure from passenger cars. The tendency in trucks is of course always toward greater load capacities, and toward ruggedness rather than refinement of detail. A significant divergence from passenger car history is shown in the development of the engine, which has met the additional demands from year to year by an increase in the size rather than in the number of the cylinders. The final drive has remained a much more open question than in the case of passenger cars. There are at least four fundamentally distinct systems still in vogue, including the chain drive so long ago discarded from passenger cars; and in addition the four-wheel-drive principle invented in the earliest days of truck manufacture continues in use by some makers, and offers another distinctive truck feature.

A little brother—sometimes, indeed, a pretty big brother—of the truck must be mentioned in the tractor. This is inherently a truck, with some means provided for taking better hold of the ground than is afforded by the ordinary tired wheels, so that it shall pull effectively when hitched to heavy agricultural machinery in the field. Wide rollers in place of ordinary wheels were the obvious first step; later these were provided with projecting plates and spikes of various sorts; finally the war, with its reinvention of the crawling, track-laying principle, gave the tractor manufacturer his biggest grip on the situation. Trucks of course have been used for hauling agricultural machinery since they first came out, just as there has always been more or less commercial use of passenger cars for light delivery work; but the tractor as an independent member of the automotive family might be dated back to 1912, with due recognition of earlier efforts.

### The Automobile in 1920

The present survey may well be concluded with a word about the position held today in the world's economy by the automotive industries. It is in a way hardly necessary to dilate upon this, yet one or two concrete statements may help to a true realization of the vital importance of the automobile to our way of doing things. For one thing, we are told that while all the railroads of the United States in the course of a year yield about 45 billion passenger-miles, the automobiles of the entire nation are responsible for 70 billion of these units of transportation. Again, with the 3,700 passenger cars manufactured in 1899, the first year for which records exist, and with the 411 trucks of 1904, we may compare the present normal production of some two million passenger cars and three hundred thousand, plus, trucks. Finally, we have the fact that there are something like seven million automotive vehicles of all sorts in operation in this country today. Figures are given for the United States for the very simple reason that, alike in manufacture and use, this is the land of the automobile.

Under the head of general remarks about the rôle of the automobile in twentieth century economy the difficulty is wholly that of finding a brief statement that shall do the subject justice. In every single thing that we do today the automobile or the truck or the tractor occupies a position of importance. Perhaps the most illuminating statement that could be made would have to do with the manner in which all distances up to fifty, seventy-five, or even a hundred miles are made to vanish into nothing by the magic influence of the motor. The isolation of farm life is a thing of the past, for the farmer cannot possibly be more than an hour from a town that gives him access to high-class schools and stores and amusements. City congestion, serious as it is, would be vastly worse were it not for the manner in which the automobile extends the suburbs and the area of food supply far beyond the remotest possibilities of twenty years ago. Trucks carry freight from New York to Philadelphia in less time than it would take to get it to the freight yards and loaded on a train. In a word, the automobile—taking this term to include all gasoline-driven vehicles—is with little question the greatest ameliorating influence in modern life. And all this is an invention, not of the past 75 years, even though for its ultimate beginnings we have to go back almost to that time; but, as regards the time which has elapsed from the first really promising attack upon the major problems involved, a development of thirty-five years at the most.

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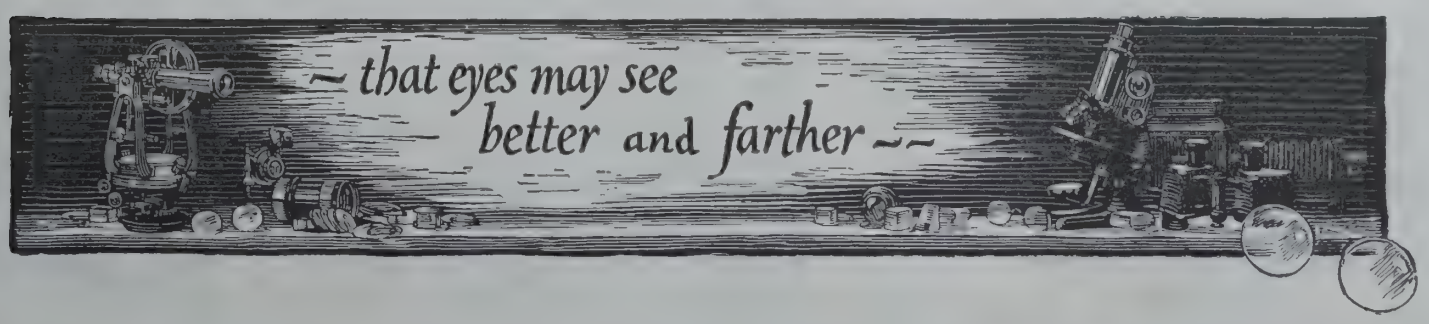

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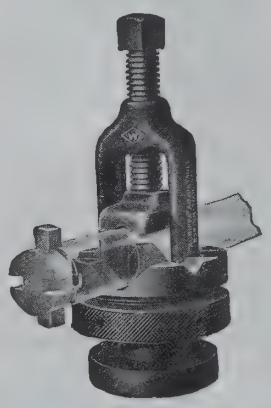

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## The Mastery of the Skies

*(Continued from page 339)*

The SCIENTIFIC AMERICAN during its seventy-five years of existence has chronicled the numerous and divers attempts at dirigible construction and travel. Thus in 1852 it chronicled the attempt of the Frenchman Giffard, who constructed a spindle-shaped balloon 143 feet long by 39 feet in diameter, and driven by a three-horse-power steam engine actuating a 11-foot screw. This dirigible voyaged from Paris at a sustained speed of six miles per hour through the air and with good control. In 1872 the German, Haenlein, with a cucumber-shaped coal gas balloon 164 feet long and 30 feet in diameter, driven by a gas engine taking fuel from the envelope, and actuating a single screw, attained a speed of ten miles per hour. In 1884 Renard and Krebs, in a torpedo-shaped dirigible 165 feet long and 27.5 feet in major diameter, driven by an electric battery motor, actuating a screw propeller, made the first return voyage against a moderate wind. The vessel showed excellent control, attained an average speed of 14.5 miles an hour, and was of model workmanship; but for lack of power it was practically abandoned till the advent of the automobile engine.

In 1898 Santos-Dumont, emulating the German Wölfert, who in 1880 first attempted to drive a dirigible with a benzine motor, sailed aloft in a spindle-shaped balloon 82 feet long by 11 feet in diameter, driven by a motorcycle engine of 3½ horse-power, carried in a car suspended beneath the envelope. Finding this vessel manageable and swift enough to make his clothes flutter, and amply rigid when its ballonet was properly inflated, he in subsequent years built fifteen more dirigibles of various designs.

Came 1900 and Count Zeppelin's début as an airship constructor. Emulating the Austrian, Schwartz, who in 1879 first tentatively drove a rigid metal balloon with a petrol motor, Zeppelin launched the first of his huge rigid dirigibles. Its hull, which was framed of aluminum and contained seventeen compartments holding buoyant hydrogen gas bags, measured 416 feet long, 38 feet across, cubed 400,000 cubic feet, weighed nine tons, and had a displacement of ten tons.

Rapid progress has been made during the past decade in dirigible construction. The Zeppelin craft have been growing steadily larger in size and power and carrying capacity. The latest Zeppelins have a length of close on to 700 feet and a cubic capacity of well over two million cubic feet of gas. Seven engines and six propellers drive the Zeppelins of today. The British rigid dirigibles are closely patterned after the German Zeppelins, and the British R-34 was to all intents and purposes a Zeppelin.

### How Man Grew His Wings

The fundamental theory of the airplane was set forth by an Englishman, Sir George Cayley, as early as 1809, and actually furnished the basis upon which the modern flying machine was subsequently built. In 1846 another Englishman, Stringfellow, gave a practical proof of this theory by building a small airplane model driven by a steam engine, which made several successful flights under perfect balance; this machine was, in conformity with Cayley's theory, a monoplane. In 1866 F. S. Wenham, also of England, invented the multiple-surfaced airplane and it was again Stringfellow who vindicated the claims of the new principle by a successful free flight of a triplane model. Further important contributions to the dynamics of the airplane were made by A. Penaud, H. Phillips, Sir Hiram Maxim, and S. P. Langley. The latter, an American and secretary of the Smithsonian Institution, built in 1903 a man-lifting monoplane which, but for its defective launching device, would have flown.

It is pretty generally admitted that the first airplane to have actually left the


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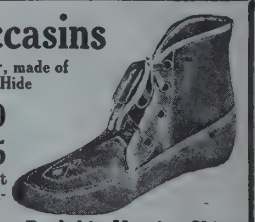

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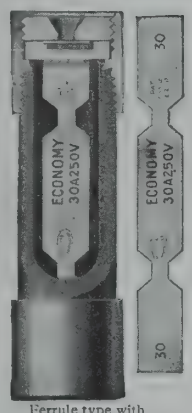

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ground, carrying a man, was the bat-shaped machine fitted with a 20-horse-power steam engine with which C. Ader, of France, made several short flights from 1890 to 1896. The balance of this machine, however, was poor, and it was only after the German, O. Lilienthal, had discovered by prolonged gliding experiments the means of controlling the balance of flying machines that progress became practical. Lilienthal's gliding experiments were repeated and perfected in this country, under the guidance of O. Chanute, by the Wright brothers of Dayton, Ohio. These brothers gave the airplane its one missing link, the warping mechanism for insuring transverse equilibrium; and having thus brought the dynamic flier under three-dimensional control, the Wright brothers fitted their glider with a gasoline engine driving twin propellers and succeeded in making their first power flights on December 17th, 1903, on the beach at Kitty Hawk, N. C.

The first float seaplane that left the water under its own power and returned thereto was built by Henri Fabre, of France, the trials taking place on March 28th, 1910, near Marseilles. Thence the development of the seaplane was chiefly due to the persistent efforts of Glenn H. Curtiss, of Hammondsport, N. Y., who produced the first practical float seaplane in 1911 and developed the following year, simultaneously with M. Denhaut, of France, the boat seaplane, or flying boat.

Particular credit for having advanced the mechanics of the airplane is due to Louis Bleriot and Edouard Nieuport, in monoplane construction; to Louis Breguet and A. V. Roe, for the development of the tractor biplane; to Gustave Eiffel, whose aero-dynamical research work placed airplane construction upon an engineering basis; to the Seguin brothers, for the invention of the rotary airplane engine, which has furthered the progress of aviation probably more than any other single development; and to Louis Chauviere, the inventor of the laminated wood propeller. With the exception of A. V. Roe, an Englishman, all these pioneers were Frenchmen. To their number may be added the Russian, Igor Sikorsky, who first built an airplane driven by several motors and thus proved the soundness of multi-engined power plants. Indeed, Sikorsky deserves unstinted praise for his foresight, and his machines were by far the forerunners of our present giant airplanes.

### What the Airplane Owes to the Great War

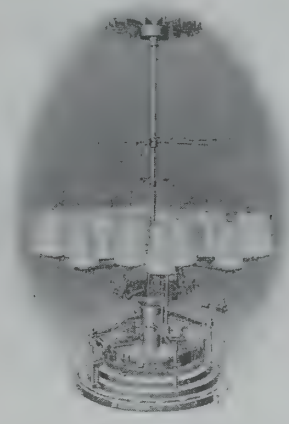
So thoroughly did the airplane prove its military worth on the battlefields of Europe that all possible efforts and facilities were concentrated on the development of the airplanes of the belligerents. The airplane was improved by leaps and bounds.

American aviation, which was at a very low ebb at the beginning of 1917, rose rapidly after our entry into the war. Once we got down to the business of producing airplanes and engines capable of competing with the best flying over the battlefields of France, we soon learned that other nations had little to teach us.

And we must not forget that the war made aviators by the tens of thousands. Until 1914 an aviator was a rare person; it was a great distinction to hold a pilot's license; few persons had gone aloft in airplanes. But with the call for fighting aviators, the various countries engaged trained thousands of young men for flying duty.

The past two years have seen the crossing of the Atlantic by airplanes, a flight from England to Australia as well as a flight from Rome to Tokyo, a flight from Mineola to Alaska, and other commendable achievements which would have been considered wild and even mad attempts but a few years ago.

The closing months of the period reviewed in this brief résumé of flying progress have been marked by the ap-


## Knitting Mills  Cotton Mills

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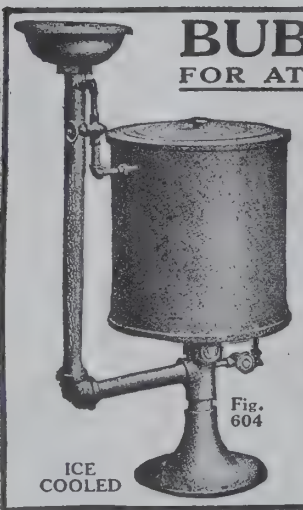

Fig. 604

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pearance of the all-metal machine in peaceful pursuits. It was during the last year of the war that Germany introduced all-metal airplanes over the battlefields of France, and those Junker monoplanes were erroneously looked upon as mere freaks not worth even copying for experimental purposes. As a result the German aircraft constructors have scored a distinct scoop, to use the parlance of the newspaperman, on the world at large. Since the war the Germans have adapted their Junker monoplane to commercial work, and as such they have a most excellent six- or eight-passenger machine which has scored many enviable records. The metal airplane, which marks a new era in airplane construction, was predicted in the SCIENTIFIC AMERICAN as early as 1910, together with the retractible chassis, gyroscopic stabilizer, and other features now realized in present machines.

## Seventy-five Years of American Patent Administration

*(Continued from page 341)*

efficiency. It is appropriate that the Patent Office should have been the scene of this innovation, for nowhere else in the Government service is the character of the personnel such a vital factor in the value of its proceedings. If Commissioner Fisher demonstrated nothing eles than the efficiency and morality of the merit system, his administration would have been among the most notable. And yet this was but one of several similarly vital reforms he introduced.

### Congressional Recognition

Frequently, an executive's hands are tied by the law. Do all he can, turn as he will, progress may be denied him owing to conditions imposed by statute. Having done all within a man's power to improve the administration of the office, but recognizing the legal limitations that barred proper development, Commissioner Fisher next attempted to overcome the inertia of the law-making body. New legislation was absolutely essential for carrying into effect his ideas as gained from his experiences, and he did not hesitate to ask for everything that he deemed necessary for that purpose.

In the first place, Mr. Fisher proposed legislation which led to the publication of the *Official Gazette* and the photolithographing of copies of patents. He was also instrumental in placing on the statute book, with the powerful aid of Representative Jenckes, the consolidated patent act of 1870. This act codified the law and, in addition, presented new features tending in the direction of modernization.

The patent act of 1870 not only introduced several broadly new features but codified the laws relating to patents, and the office is now running substantially on the basis of that act. The most important innovation since that time was the creation in 1883 of the International Bureau for the Protection of Industrial Property, by which the residents of every subsidiary country have reciprocal rights in all the other countries in regard to applying for patents and the procedure connected therewith in the respective patent offices.

### The Patent Office and the Courts

Another change of momentous influence was the modification of the jurisdiction of the United States Supreme Court. Up to 1891, the highest court of the land assumed appellate jurisdiction in patent causes. Since that time, except in highly specialized instances, the courts of last resort in patent litigation are the nine separate circuit courts of appeal. There has resulted from this change, made necessary to relieve the docket of the United States Supreme Court, a confusion of principles, an uncertainty in patent rights and an inconsistency between the frequently inharmonious views of the different but equally important jurisdictions.


# PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

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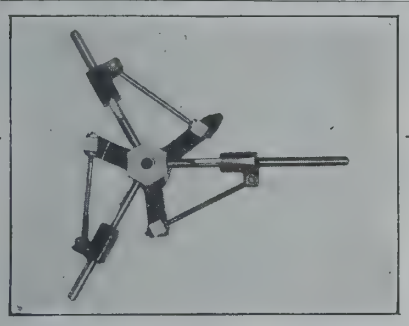

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But the greatest loss has been in the absence of those great decisions formerly handed down from the Supreme Court bench.

The patent system established by the act of 1836, creating the so-called "American" or "examination" method of granting patents by which scientifically and legally trained men scrutinized the technical merits of the invention, compared it with all known like efforts by an examination of every available printed record, and determined the form and legal limitations of the grant, has been pronounced to be the greatest piece of constructive legislation ever placed on our statute books. Certainly, no law designed for purely national aims has ever been copied so extensively as this. Almost every nation which has any pretension to being influenced by modern industrial tendencies, has adopted it or adapted it to its own purposes. This law thrust upon the Patent Office a substantial portion of the legal work that had hitherto devolved upon the courts. It was a radical departure from all existing systems, which merely provided for the "registration" of the application when deposited in the Patent Office, and gave the patent neither legal nor industrial value.

Under the registration system, patents were granted to others than the inventors, or for inventions that were old or inoperative. This system was tried out for 33 years previous to 1836, and created such uncertainty in the patent situation, opened the door to so many frauds, and was productive of so much unnecessary litigation, that it became more of a menace to industry than a help, and depressed the spirit of invention rather than stimulated it. England, as already stated, discarded this system.

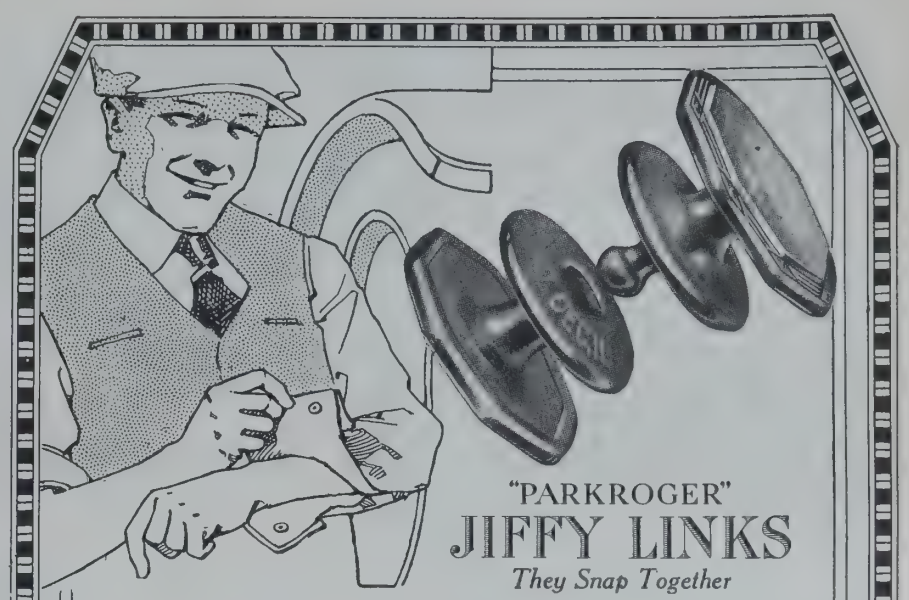
Germany and Japan, the two countries above all others in recent times which have had their eyes open to the main chance, have copied the American or "examination" patent system. No other nations ever made such conscious, deliberate and studied attempts to achieve material success, and they went to every other country to learn what it most had to offer, and did not hesitate to borrow and adopt from it what they found most of value.

### Our Patent Growth

America is the land of ingenuity, and the national genius finds its outlet in invention. As far back as 1857, the applications filed in the U. S. Patent Office exceeded those filed in England by one-third, and since the founding of this government, almost as many patents were granted in the United States as in England, France and Germany combined. The measure of the activity, however, of the Patent Office is indicated by the applications filed, and not by the patents granted. It is curious to observe in this respect how the history of the great war repeats the experience of the Civil War. The heaviest year in applications filed preceding the latter event was in 1860. In 1861 occurred a decided dropping off, succeeded by gradual gains in the following years. In 1864, with the end of the war in sight, a marked increase took place, while in the three succeeding years the business jumped by leaps and bounds.

So in the more recent event—the year 1916 saw the largest business ever presented to the office up to that time. Our entrance into the war did not make itself felt until several months later, but in 1918 its full effect was shown in a 15 per cent drop in receipts from the average of the seven preceding years. Before the year 1919 got well under way, the effect of the cessation of hostilities became apparent, and by summer the receipts began to exceed those of the heaviest of preceding years.

The intimate association between industrial progress and inventions is shown in the history of two inventions developed during the life-time of the average college boy. The automobile and the moving pic-

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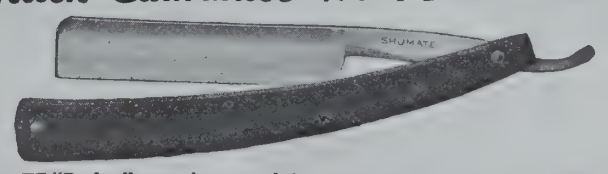


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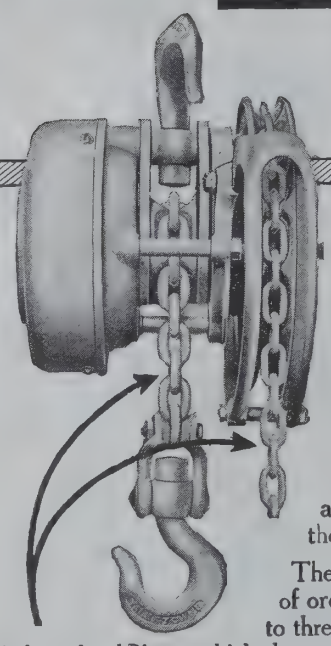

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ture were merely experimental features at the beginning of the century. Today, the film picturizations directly and indirectly involve capital employment going into the billions, while the annual output of automobile and accessory producers aggregates the amazing figure of three and one quarter billions of dollars, which is more than three times as much as the total aggregate of *all* production in this country in 1850, when we had a population of 23,191,876. The automobile has jumped Detroit in ten years from a city of the third class to one in the first class, while the "movie" has made Los Angeles a near-metropolis and given it international renown. The difference between countries influenced by invention on the one hand, and removed from its effects on the other is strikingly shown in a comparison in material welfare between United States and Russia.

### The Diamond Jubilee of the Scientific American

(*Continued from page 343*)

stitution of a carbon paper ribbon. Compliments from our subscribers came from all over the world; for when once in typewritten form there was no difficulty in transferring the matter lithographically and printing in the "offset" presses.

### The Scientific American Monthly

In 1876 the Centennial Exhibition offered such an alluring field, with its vast stores of information, that it was decided to publish the SCIENTIFIC AMERICAN SUPPLEMENT. When the Exposition closed the SUPPLEMENT was too well liked by the subscribers for the publishers to abandon it. Tihs popularity remained with the successive volumes until it was decided to bring it out in monthly form, beginning January 1, 1920, under the name SCIENTIFIC AMERICAN MONTHLY.

In the few months which have elapsed the MONTHLY has proved its worth, and is conceded to be the best scientific periodical of its type in the world.

### The Various Homes of the Scientific American

The business homes of Munn & Co. and the SCIENTIFIC AMERICAN in New York have been few in number.

First, 1845-1859, Sun Building, Fulton & Nassau Sts.

Second, 1859-1882, World Building, 37 Park Row.

Third, 1882-1884, 261 Broadway.

Fourth, 1884-1915, 361 Broadway.

Fifth, 1915 to date, Woolworth Building.

Messrs. Munn & Co. have their own building in Washington, adjacent to the Patent Office, so that the business of their clients can be expeditiously handled. Branch offices are also maintained in Chicago and San Francisco.

It is very seldom in this country that a business enterprise remains in the same family for a period of nearly 75 years. It seems appropriate, therefore, to commemorate the event in a becoming manner. The son of one of the original founders is president of the present organization and his grandson, its treasurer.

### From Wet Plate to Motion Pictures

(*Continued from page 346*)

when exposed to light in combination with bichromate of potash. This observation was first made by Becquerel. The next idea evolved was that gelatine made insoluble by light might be made to imprison particles of coloring matter. Where light acted, these would remain; where it did not act they would wash out by reason of the insolubility of the portion of the films in which they were contained. This was an important step and was made by Poitevin in 1855. The carbon process now used was invented and patented in 1866 by J. S. Swan.

### When the Dry Plates Replaced the Wet Plates

Dry plates were proposed as early as 1854 by Gaudin in France and Muirhead


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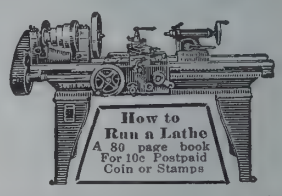


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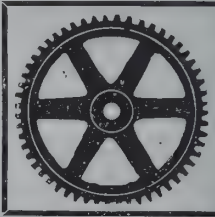

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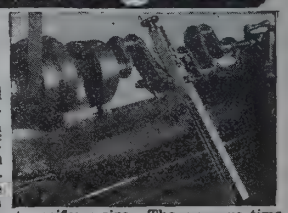

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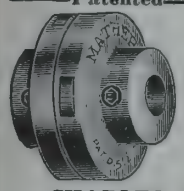

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in England, and J. M. Taupenot seems to have been the first to have invented a practical dry plate. His process was cumbrous. It was not until Major C. Russell introduced the alkaline developer in 1862, which necessitated the employment of silver bromide on the sensitized glass, that the dry plate really became workable by anyone. His dry plates were the forerunner of those we now employ.

Up to the time of W. B. Bolton and B. J. Sayre's experiments in 1864, silver iodide had been considered the staple of a sensitized film on which to take negatives. It occurred to them to bring the sensitive salts of silver in collodion while liquid and to form a sensitive film merely by letting the collodion, containing the salts in suspension, flow over the glass plate. Thus the collodion emulsion process was born—a process which revolutionized photographic manipulations. M. Carey Lea and W. Cooper, Jr., placed the process on a commercial basis by improvements which made the plate more sensitive.

Since silver bromide emulsion could not be prepared in collodion, naturally experimeters began to cast about for collodion substitutes. The researches of Madox, King, Burgess, but above all the work of R. Kennett and C. Bennett, from 1871 to 1878, resulted in the gelative emulsion process of making dry plates.

### The Rise of the Film Camera

Dry plates were too heavy and cumbrous for the amateur. A thin, rollable, continuous, transparent strip, which would carry the negative, was required. That need was supplied by the celluloid film which was invented by the Rev. Hannibal Goodwin in 1887. There can be no doubt that the celluloid film was also independently worked out by Eastman and his chemists; certainly the commercial film came from George Eastman and his associates.

Eastman has contributed more to present-day photography than any other worker in this field. He followed up the commercialization of film negative by developing the handy camera which he called the "Kodak." The first camera of this vast camera family appeared in 1888. It took round pictures, 2½ inches in diameter, had a fixed focus, and carried a roll of 100 exposures. Compared with the cameras of today, it was crude, to be sure; but in its time it marked a vast stride forward and started the true era of amateur photography. Later Eastman made his film cartridge light-proof, thus introducing the daylight-loading feature.

Year after year film cameras, as well as hand cameras in general, have been improved and refined. It is only a few years ago that cameras were generally fitted with simple double lenses of the rapid rectilinear type in place of the simple, meniscus lenses of an earlier period. Today practically every camera intended for anything like good work is provided with anastigmat lenses.

Again, it is only a few years ago that the autographic feature was made part of the kodaks, marking another big step in making the camera a useful article rather than a chance sport.

Space does not permit us to delve into the interesting subject of color photography, which, strange to say, is a phase of long standing. Suffice it to mention that color photography has received the attention of a host of inventors and experimenters, but even today it does not seem to have developed to a simple enough stage to warrant its universal application.

### Pioneer Days of Motion Pictures

It was the invention of celluloid film that made motion pictures possible on a commercial scale. Prior to the introduction of film there were numerous attempts at motion pictures, beginning with Dr. Coleman Sellers of Philadelphia, who took out a patent in February, 1861, for what he called a "stereoscopic cabinet," but which came to be known as the "kinemat-

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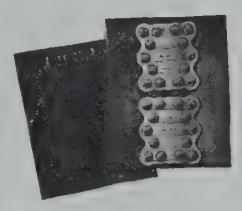

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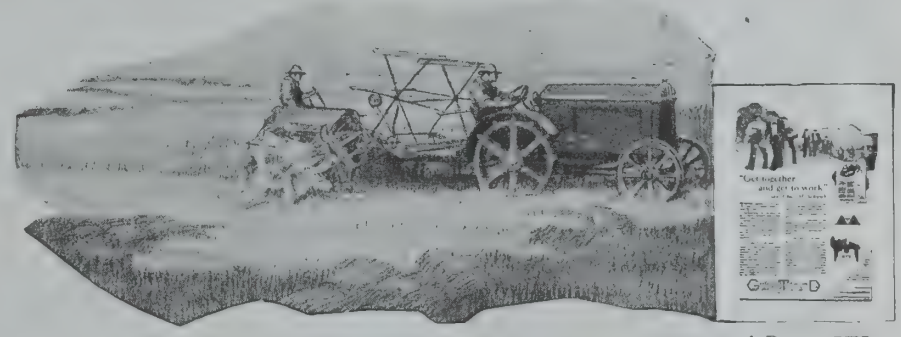

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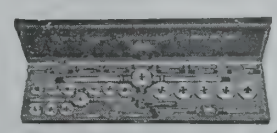

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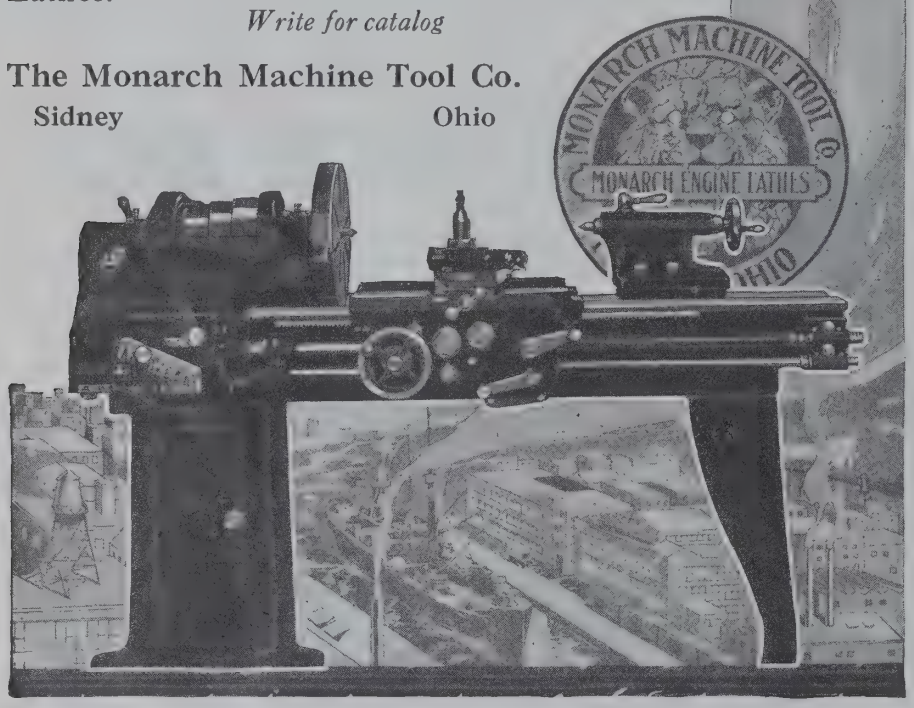




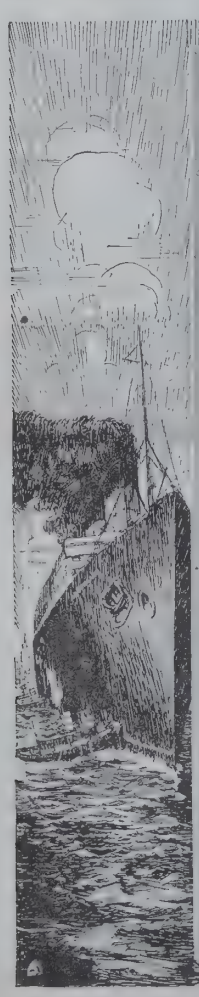

IT was Sir Samuel Cunard and his associate founders of the Cunard Line who really gave the first impetus to systematic transatlantic travel, eliminating its discomforts and making ocean travel an allurement to countless thousands who now speed upon their way of business or enjoyment with a feeling of comfort and luxury.

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oscope." Because he introduced the intermittently moved ribbon-like picture carrier, Sellers is in a sense the father of motion-picture photography. Others who worked on the motion picture were Donisthorpe in 1878, Marey in 1881, and Reynaud in 1889. While all of these adopted and employed perforated picture ribbons, Marey employed the celluloid film.

The intricacies and conveniences of the camera naturally depended on the kind of plate being used. In the camera used by Niepce and Daguerre, the focusing was accomplished by sliding the lens back and forth. Daguerre, in 1839, focused his camera by having one section sliding in or out of the other. Then followed the camera with stationary front and the back sliding upon its base with a set-screw and connected with the front by means of a bellows. It remained for the American inventor, George Eastman, to simplify and refine the camera and accessories of those days so as to make amateur photography what it is today.

Credit for giving the first exhibition of motion pictures goes to Henry Heyl of Philadelphia. In 1870, Heyl exhibited his "Phasmatrope" before an audience of over 1,500 persons. The related photographs were small glass positives of selected subjects reduced from wet plate negatives, taken from successive poses, by an ordinary camera.

Then there is the work of Edward Muybridge, whose horse-galloping pictures made him famous. His remarkable studies of animals in motion were made with a battery of cameras. His work was more scientific than of commercial value. Muybridge did design, about 1880, his "zoopraxiscope" to exhibit his glass plate positives of animal movements. This was similar to Heyl's work.

In 1889 Edison made his first motion-picture camera in which the film was intermittently moved. His earliest form of exhibiting apparatus, known as the "kinetoscope," was a machine in which a positive print from the negative obtained in the camera was exhibited directly to the eye through a peephole. In 1895 the films were applied to modified forms of magic lanterns and the images projected on the screen.

Another pioneer in the motion-picture field was C. Francis Jenkins of Washington, D. C. In 1893 and again in 1894 this inventor exhibited a projector which, in its essentials, was practically a modern projector. Again Lumiere gave the first public demonstration in Paris in 1895, with his kinematograph—a combination camera-projector which exhibited pictures of remarkable beauty.

And there are scores of other workers, each contributing something to the development of motion-picture photography. And all these efforts finally resolved themselves into a standard sized film which today is in universal use. The equipment, too, has been standardized. Indeed, no industry of such magnitude can boast of more complete standardization, which feature has gone far to make the motion picture a commercial and universal success of the first magnitude.

There have been motion pictures in colors. Many attempts have been made to add color to the screen, and many of these have attained no mean degree of success. Today several methods of obtaining natural color effects are in use. It has been said by one school of the art that color pictures will rule supreme within a few years; and it has been said by an equally emphatic school that black-and-white pictures are here to stay, and will never be ousted by color pictures.

Again, there have been talking pictures, but these have not met with much success from a commercial standpoint. The main difficulty in this direction is that the technical development has not advanced to a satisfactory point. And even allowing technical success, the fact remains that the present films can get along without sound.

# $5,000 Prize Essay

## The Einstein Theory of Relativity

Mr. Eugene Higgins offers through the SCIENTIFIC AMERICAN a prize of $5,000 for the best essay on the Einstein theories so written that it may be read with profit by an ordinarily intelligent person with no special mathematical training. The competition is open to any person, without restrictions of any sort, subject to the following

**CONDITIONS:**

1. No essays shall be longer than 3,000 words.

2. All essays must be in English, and written as simply, lucidly and non-technically as possible.

3. Each essay must be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted.

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The Committee of Judges will consist of Professors Leigh Page of Yale and E. P. Adams of Princeton. In the event that they are unable to agree on the best essay, the Einstein Prize Editor will cast the deciding vote.

IN THIS ISSUE:

A NEW DEAL IN TRANSPORTATION
WHAT ABOUT OUR WHEAT PRODUCTION?

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

WITH THE CHEMISTS WHO KEEP TABS ON OUR LEADING INDUSTRIES

Vol. CXXIII. No. 15
October 9, 1920

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# STRENGTH

## WITH PLENTY OF MARGIN FOR THE EMERGENCY

FROM the standpoint of materials, it is reasonable to assume that every motor truck is strong. The intelligent truck purchaser can judge material strength by appearance. But continuous performance demands strength of design to supplement strength of materials. It is an honest combination of the two which enables the Clydesdale truck to serve its owner faithfully without costly interruptions.

For instance, the Clydesdale frame is of pressed steel, *shaped so that the greatest strength comes at the point of greatest strain.* It is two inches deeper than the average, and is gusseted at every corner and cross member, so that no twist of road or load can possibly bend it. Compare this construction with rolled steel frames which cannot be so shaped, and one reason for Clydesdale sturdiness is apparent. Fewer repairs and slower depreciation are worth considering.

THE CLYDESDALE MOTOR TRUCK CO.
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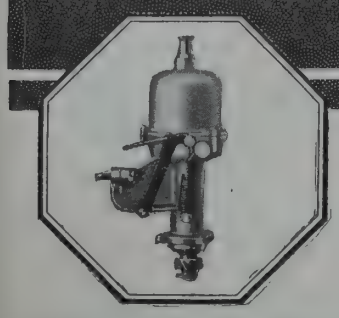

### How This Controller Conserves Strength

The strength of most trucks is taxed to the utmost by the sudden strain put upon them when the motor is raced to get the load quickly under way. The speed of the motor is too great for the starting speed of the rear wheels, and every part is called upon to stand the shock until the speed is equalized. With the Clydesdale Controller to act on the gas supply, this cannot happen, since the motor starts the load *slowly* and picks up gradually to the speed set on the throttle. No part is jerked into doing more than its share.

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Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

# The Scare Circle

*According to the National Board of Fire Underwriters, one of the chief causes of community fires is the inflammable roof. Over a hundred cities and towns throughout the United States now have ordinances against this menace.*

SUDDENLY, without warning—Fate takes up the compass and putting down the pointer on some peaceful community, she decrees "This place shall be burned." Then swinging an arc she draws a circle—"These people shall be fear-stricken."

In the scare circle, around the fire, the horror of what might have been, brings fire prevention home to those in it and with sharpened realization Insurance is written, legislation is rushed through, fire safety devices become necessities, fire safe roofings compulsory.

And all this is perfectly human and in its restricted effect, it is the price a locality pays for greater fire safety.

But the scare circle is no longer a mere local panic. It has widened in significance, for today our fire loss is a National scandal, a cause for general concern.

Public men speak of it with grave emphasis, organized safety bodies deplore it. For fire prevention is no trumped up propaganda, no phantasy of the imagination. It is a living blight right here among us, blocking and mocking our plans to catch up in our building program; burning down ten buildings while we plan a hundred; squandering wealth; diverting labor and disturbing the very tranquility on which our development depends.

Fire prevention is a national responsibility. But it is more one of personal action than legislation. To each of us some preventative measure is possible. Each must set up his own safeguards to fortify his own property.

The spread of fire is nothing more than one building catching the flame from another, usually from roof to roof. So the roof is one of the most vulnerable spots where fire can strike.

That is why Johns-Manville Asbestos Roofing is recognized everywhere as an important prevention against fire's spread. For, it is the only all-mineral roofing felt and so while possessing all the flexibility of fabric and adaptable therefore to all kinds of roof surfaces, it is at the same time inert to fire, weather and fungi.

So Johns-Manville Asbestos Roofing either in its "built up" or "ready roll" form or as shingles, is not only fire-immune but the most remarkable of roofings. Because it is all mineral it is impervious to all the ravages to which ordinary roofings are subject.

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# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII
NUMBER 15

NEW YORK, OCTOBER 9, 1920

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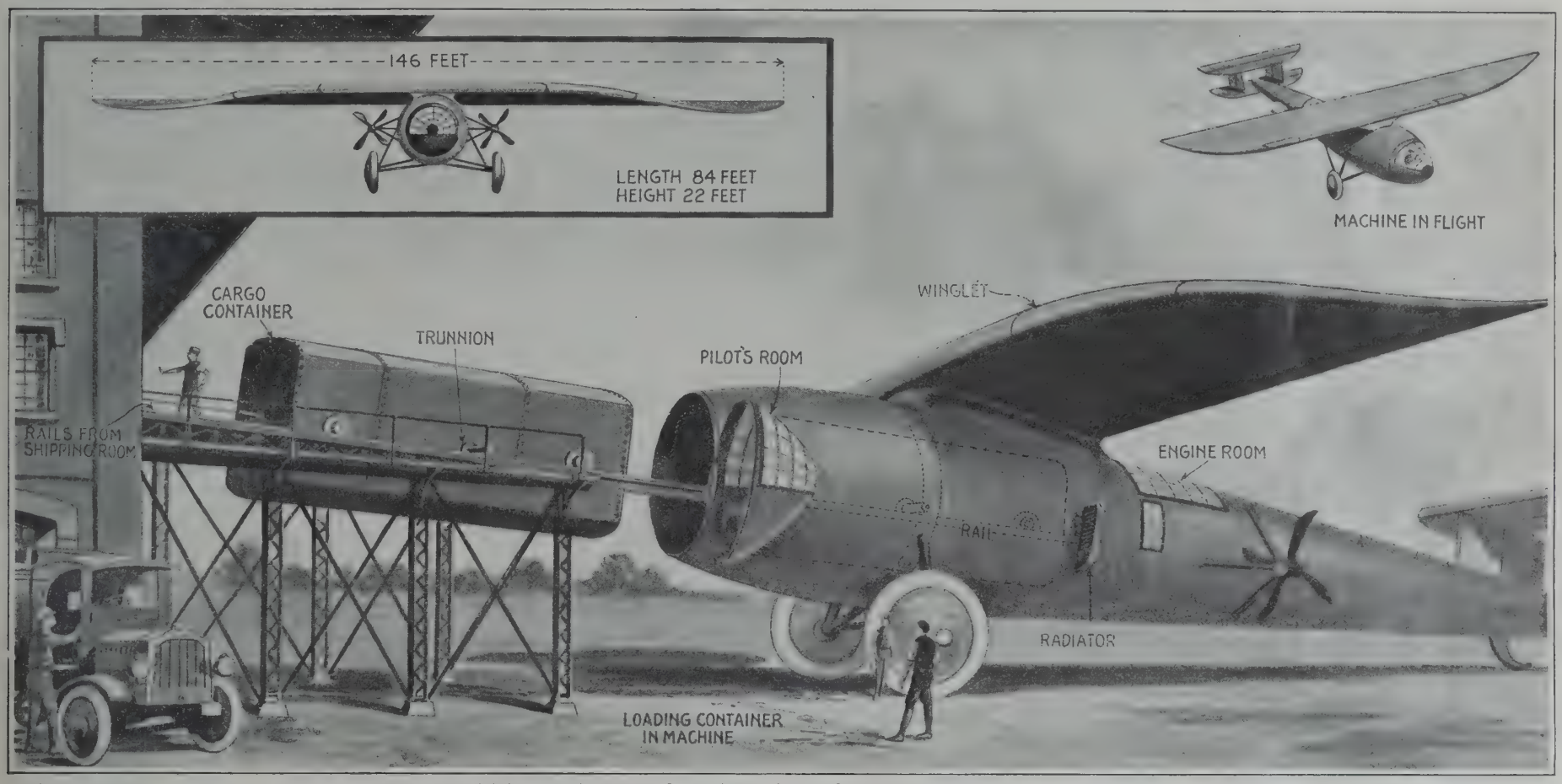


**The development of a new high-lift wing by British experimenters has given rise to designs for a four-ton cargo-carrying monoplane of this type, together with a system of rapid loading and unloading as here depicted**

## The High-Lift Wing and Commercial Aviation

LET us be perfectly frank in the matter of commercial aviation. We must admit by now that just so long as we stick to the present principles of design and construction, just so long do we defer the extensive employment of airplanes for passenger and cargo carrying on anything like a large scale. For it is obvious to even the layman that our present costs of operation are far too heavy to make commercial aviation commonplace. We must take it out of the luxury class to make it an everyday commodity.

Aeronautical constructors, realizing the aforementioned conditions, have been striving for years back to increase the efficiency of the large airplane, or to put it another way, lower the operating costs. Here and there certain efforts are now being consummated in the form of improved propellers, engines, and, most important of all, high-lift wings. Indeed, it seems that certain of these efforts are well along the right road and that commercial aviation is about to enter a new and more practical era.

Not so long ago Mr. Handley-Page, the well-known British aeronautical constructor, announced a new wing which had been developed and for which he claimed a considerable gain in efficiency over the usual types. And more recently a group of British experimenters have introduced a new wing which has been tried with most promising results. It is with the latter that we have to deal in the following lines.

The new wing, which has been named the "Alula," is the result of some eight or nine years of steady experimentation on small and full scale models and the expenditure of no mean sum of money. All these experiments have been directed toward producing a wing with high lifting power and low head resistance. The experimenters argued that this could only be obtained by discovering a wing which produced over its surface the type of air flow known as "irrotational" or "two dimensional"; that is to say, an air flow moving along a line which only rises or falls, but does not move sideways in a third dimension.

This type of air flow is obviously strictly parallel to the direction of flight, and so it may be assumed that none of the energy imparted to the air is wasted in side movement. The idea is, in effect, the idea of the perfect stream-lined strut or fuselage applied to the wing itself, in relation to which designers have hitherto been singularly careless in this respect.

It is claimed for the new wing that it eliminates all "end losses" and leakage, which reduce the efficiency of other wings and waste much energy in vortices. And thus it is claimed that a high percentage of the power put into the wing by the engine is given back in actual lifting power, which is as it should be in a vehicle dealing with that most elastic of all substances —the air.

As the result of the prolonged period of experimentation already referred to, it is now possible to vary all the features or factors of a wing in unison—or perhaps one should rather say, in harmony; so that when it is necessary to vary one dimension of a wing, all the other component dimensions may be varied in proportion and pre-ordained results may be obtained. It is of interest to learn that the wing shape produced resembles closely the wings of the most powerful birds, although the experimenters and Nature apparently arrived at the same conclusion by different methods.

The experimental machine, which is a species of parasol monoplane, with the wings raised above the slipstream of the tractor screw, has made successful flights. Pilots will be interested to hear that the machine equipped with the new wings refuses to obey the control of ailerons, and that it is controlled laterally by moving a hinged portion of the leading edge of each wing. This movement controls the direction of the machine as well as its lateral position, so that the rudder is not used in conjunction with the lateral control—which feature, according to our worthy contemporary, *The Aeroplane*, to whom we are indebted for many of these facts, would seem to abolish the Wright patents. Also, it is stated that if the slip stream of a tractor screw is allowed to flow over the wings, it entirely spoils their lifting power.

Actual designs have been prepared with a view to applying the new wings to commercial purposes. These call for a cargo machine to carry four tons. The proposed machine, known as the "Pelican Four-Ton Lorry," is a colossal cantilever monoplane designed for two 460-horse-power Napier engines. Its cruising speed is 72 miles per hour, its top speed 96 miles per hour, and its landing speed 55 miles per hour. Its total weight is to be 24,100 pounds. The wing loading figures out at 12.9 pounds per square foot. The useful load is four tons, with sufficient fuel for the London-Paris journey. Most interesting of all, however, is the novel system of quick loading and unloading which has been planned. This permits of handling shipments with the utmost speed, and is based on a similar practice in the motor truck field. Idle airplanes mean a large idle capital, hence the designers plan to keep the airplane in the air for the greater part of the time.

# SCIENTIFIC AMERICAN

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**New York, Saturday, October 9, 1920**
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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## For an Independent Naval Air Service

AS a result of the extravagance which marked our efforts to build up a powerful air service and place a large fleet of machines at the front during the late war, there is a movement afoot to combine all our activities in one united aviation service. Although powerful arguments were brought forth this year in favor of the measure, it was realized that there were many defects in the measure and the proposition was defeated.

In no quarter did such strong opposition develop as in the Navy Department, where it was felt that the propaganda which was carried on in support of the bill contained many flagrantly inaccurate and misleading statements concerning naval aviation, and that if the bill became law, it would result in taking away from the Navy the control of its own activities in the air. The SCIENTIFIC AMERICAN has already gone on record as favoring a certain measure of unification, at least so far as the matter of appropriations is concerned; but we believe the Navy is absolutely in the right when it demands that in respect to design and construction of engines and machines, in the training of personnel and in the disposition and control of its own airplane forces, it should be left absolutely supreme.

Both precedent and common sense call for the organization within the Navy of a Bureau of Aviation, which shall control its own aviation activities and coördinate them with those of the Army. It is believed that, only if the Navy has a bureau organization for aviation, will it be able to take the strong position in the air which rightly belongs to it. Failing the establishment of such a bureau, aviation will drag along in the more or less haphazard way that has characterized the development of the submarine.

Aviation is so unlike any other branch of naval activity that it is entitled to a separate bureau of its own. The design and construction of the hull of a warship is an entirely distinct activity from that of designing its engines, and the design and construction of the guns and armor are as widely distinct from both. Consequently, we have already in the Navy the separate bureaus of Construction and Repair, Steam Engineering, and Ordnance. But if each of these is so individual as to require its separate bureau, how much more so is aviation! Unlike the three mentioned, it is a new art which only yesterday was in its infancy. We venture to say that it is the most difficult of the four, surpassing them in its complexities and in the number of its major and unsolved problems. It is evident that industrially, in the preparation for war, the matter of aviation organization is of prime importance. Congress and the public are familiar with the figures giving the expenditures for aviation in the Army and Navy during the recent conflict. They know also what results were achieved. The first thought that comes to any of us when we consider the future of governmental expenditures is, how may the extravagant wastefulness displayed during the recent war be avoided if, unhappily, we should find ourselves concerned in another war. In considering the question, one fails to see any organization in effect today which is greatly superior to that which existed in 1917.

If, in the forthcoming discussion of this matter, there is found to be a general agreement that we should have a united air service, we are strongly of the opinion that such an air service should concern itself only with general coördination in the matter of the allotment of the appropriations provided by Congress. It should leave to the separate departments, War, Navy, Post Office, et cetera, the determination of all technical matters; for only the experts in these several departments are familiar with the various problems to be solved, and they alone are qualified by knowledge and experience to make the best solution.

It is particularly in this last regard that the naval authorities demand that they be given an absolutely free hand. The art which has to do with the design, construction and operation of warships is in a class by itself. Familiarity with its problems can be gained only by long and intensive training, and the problems which arise in naval aviation, whether it be in strategy or tactics, are quite distinct from the roughly parallel problems of the army service.

In conclusion, let us bear in mind that so far as production in time of peace is concerned, the number of planes produced for governmental purposes is not numerous. Moreover, since all of the work, whether for Army, Navy, or Post Office, is experimental and progressive, standardization at the present time of types of machines and mechanisms is undesirable, if not impossible. It is desirable that the various problems should be attacked by many minds rather than by an individual organization, the results of these separate efforts to be of course coördinated. We believe, moreover, that prizes and rewards should be offered to civil competitors for excellence in designs of machines and mechanisms—an attitude on the part of the Government which we believe would greatly stimulate the art.

## Safeguarding the Weapons of Science

THE horrible crime which was recently perpetrated in the heart of the Wall Street district reminds us that the powerful agencies which the developments of science have put into our hands for the prosecution of works of utility may be used by vicious and depraved minds for wholesale destruction of life and property. It is but small consolation to realize that this tragedy will concentrate public attention upon the fact that the manufacture, sale and use of high explosives must henceforth, in the interest of public safety, be surrounded with a double safeguard. The unfortunates who were killed and mutilated will have died and suffered in vain if the authorities do not take up this whole question and enact legislation that will make the repetition of such crimes extremely difficult, if not impossible. Offenses like this remind us that the benevolent fruits of our progress in discovering and manipulating the forces of nature have something of the effect of a two-edged sword. Directed to their proper and intended uses, modern inventions have done more to promote material comfort in the past century than was achieved in all the previous history of the world; but we must not forget that in the hands of the depraved and vicious, these same inventions may be used with deadly and far-reaching effect as instruments of malice and revenge. The criminal who breaks into the home goes armed with the finest automatic weapons, and rarely today is the robbery of a bank attempted without the accessory of a waiting automobile at the sidewalk.

It is one of the baneful legacies of the war that it has furnished the criminal with more deadly weapons such as poison gas and the hand grenade, and it takes no great stretch of the imagination to conceive of the airplane being pressed into service as a sure means of obliterating the trail of the man who has taken the life or seized the property of the law-abiding citizen.

The use of modern inventions for criminal purposes has been foreshadowed by more than one of the popular scientific writers of fiction. We can all remember with what frequency during the war both sides were credited with having made use of virulent germs as a secret and deadly means of exterminating the enemy population; and to the lunatic as distinct from the more positively criminal type this agent of destruction might make a particular appeal.

Now it should not be beyond the resources of our highly developed civilization to find ways and means of restricting the more potent and deadly substances and appliances to their proper uses. It may be found that to do this would involve a strict supervision of the individual citizen and a certain restriction of his individual liberty. If so, he can comfort himself with the thought that it is a universal law of life that the many may be called upon, at times, to suffer discomfort because of the vicious tendencies of the few. To the law-abiding citizen, the thought of close supervision is unpalatable, if not repulsive; and it is not likely that in the immediate future we shall come to any such conditions. Nevertheless, the experience of the two years which have intervened since the armistice proves beyond a doubt that crime is tending to make an increasing use, or rather misuse, of the weapons which, largely as the result of the war, have been thrown in its way.

There has always been a strong prejudice among us against the methods of police registration and supervision which have characterized some of the countries of Europe; but our prejudice has been mainly against the motive of this rather than against the supervision itself. Certainly there is something wrong with the present conditions when one man, or several criminals working together, can prepare a huge bomb, load in on to an open wagon, haul it at the busiest hour of the day into the most densely crowded center of the city, and there set it off, all apparently according to carefully calculated time and schedule. If any scheme of general registration can successfully combat this sort of thing, it is a cheap price indeed to pay for the safety of society.

## Rounding Out the State Barge Canal

THE State Barge Canal as an engineering structure is an accomplished fact. Although the work remaining to be done is of a subsidiary character, it is of a kind that is absolutely essential if the canal is to realize its full traffic potentialities. This work consists in the construction or completion of proper dock facilities not only at the terminals on Lake Erie and at the Port of New York, but also at the various shipping points along the canal.

Foremost among these works is the provision of suitable terminal grain elevators at Buffalo and New York; for it must not be forgotten that it was largely the Erie Canal which gained for New York the position which it once held in the grain trade. It has long been realized that before private capital will build the necessary barges the State must provide terminal grain elevators designed especially to accommodate barge canal traffic. The existing grain elevators are owned by the railroad companies, and naturally the grain that comes to New York by railroad will have the first call upon these facilities.

For these reasons, those who are anxious to see the grain trade to this city win back its former position will welcome the announcement of the State Engineer that the plans for the public grain elevators have been completed and will soon be presented to the Canal Board for approval. These plans, which have been approved by a committee appointed by the New York Produce Exchange to coöperate with the State Engineering Department, are to have a capacity of 2,000,000 bushels of grain, with provisions to increase this whenever future developments of traffic call for it.

It is gratifying to know that the Barge Canal is proving to be adequate and efficient, testimony to this fact having recently been furnished in a report by a corporation which is operating fleets of modern steel barges on the canal and which contemplates extensive additions to its facilities in the near future. The report states that the vast possibilities of the canal as a link between the Great Lakes and the sea were duly considered by the officials of the corporation while its barge fleets were in contemplation. Each unit of its fleet averages eight days between the Hudson River and Lake Erie. These units consist of four barges of 400 tons deadweight, each towed by a steam tug, the fleet moving as much as could be carried in three train loads of 50 cars with a minimum of twelve tons in each car. The company states that the buoying of the canal and its general upkeep is very satisfactory, and it is believed that America's inland waterways will be second in importance within a few years' time to the present great development in deep sea shipping.

## Electricity

**Simplifying the Radio Telephone.**—There has recently been introduced a radio telephone outfit which operates without a "B" battery or external source of high potential. The entire outfit may be readily transported. The transmitter weighs 60 pounds, including two six-volt storage batteries. It operates with any suitable type of receiver and audion detector, with or without an audion amplifier, depending on the range, loudness and so on. The set is designed to operate an antenna whose capacity to earth varies from 0.002 mf. to 0.0007 mf., although it may be used on even smaller antennæ.

**Electric Heating in Switzerland.**—An authority has recently undertaken an analysis of the heat energy required in Switzerland's climate and finds that on an average 2,500 kilowatt hours per person in the winter season will be sufficient for heating not only residential apartments but also offices, factories, and so on. For the heating only a total of 10,000,000,000 kilowatt hours would be required per year in Switzerland, or just one-half of the maximum total of hydraulic energy which could be utilized per year by careful development of all available waterfalls. A difficulty with electric heating is the seasonable demand, which prevents a high economy. The author does not expect a general application of electricity for heating purposes.

**Electric Vehicle Progress.**—A rather complete survey of the electric vehicle field is presented by F. Ayton in a recent issue of *The Electrician*. It is stated that in England the superiority of the electric truck for delivery and other service in urban and suburban areas has been admitted. Moreover, the soaring cost of fuel for the internal-combustion engine, not to speak of the extremely heavy cost of keeping in repair vehicles fitted with this type of motor, is giving a greater and yet greater advantage to the simple and economic "electric." These facts apply to conditions in England, of course, where fuel is exceptionally high. Attention is also called to the DeMartis lead type of "lead-acid" battery of Italian origin, in which it is claimed that by the use of a special paste which combines extreme hardness with great porosity, formation of lead sulfate is prevented. Other advantages claimed for this battery are higher capacity for the same weight, slightly higher voltage on discharge, and increased watt-hour efficiency.

**Why Not Electrify Railroads Now?**—It is the consensus of opinion among manufacturers of electrical equipment and supplies that the next year or two will see a great boom in the electrification of our leading railroads. Now that the railroads are facing the stern necessity of purchasing new equipment not only to replace that which has become obsolete, but also to take care of the increased traffic, it would seem that the opportune moment has arrived for electrification on a large scale. Ultimately, it is argued, the railroads must come to electric operation, and the longer they put off the conversion the more equipment they are certain to pile up against the day when it must be scrapped. Furthermore, electrical men claim that the increased efficiency of electrified railroads would go a long way toward making up the cost of the change at this time. The main deterrent at this moment seems to be the financial situation, which does not favor the expenditure of vast sums of money on anything which does not promise an immediate and profitable return. Nevertheless, it would appear that the ultimate economies to be attained through electrification are sufficiently attractive to make it decidedly worth while for our railroads to go to some effort to take advantage of them; so we look for at least partial electrification on a notable scale in the near future.

## Science

**Eruption of a Geyser in France.**—A French geologist, M. Glangeaud, has transmitted to the French Academy of Sciences a report on a geyser-like phenomenon recently produced in the course of the boring of a well in search of petroleum on the plains of La Limagne. The hole had reached a depth of about 500 feet when there was a sudden eruption of boiling water, which rose above ground in a jet 130 feet high and hurled the boring tools, weighing two tons, into the air. Hot water was still flowing from the well at the time of the report. The water, which has been analyzed, is highly charged with carbonate of soda and other salts, as well as carbon dioxide.

**The Velocity of Explosive Sounds.**—The sound-waves produced in air by a sudden explosion travel at first faster than do ordinary sound-waves. Some interesting experiments have recently been carried out by Dr. Dayton C. Miller for the purpose of obtaining exact data on this point. The experiments were made during the firing of large guns, mostly 10-inch and 12-inch rifles, at the Sandy Hook Proving Ground. The amount of powder charge and the value of the internal pressure developed in the gun were taken into account. The sounds were received by specially constructed carbon-granule microphones, and by others of a very sensitive type. The records were made by a moving-film camera in connection with a string-galvanometer capable of recording from six stations simultaneously; the same type of apparatus used by the army for sound-ranging. Stations were located at the muzzle of the gun, and at various distances up to 21,000 feet. Detailed meteorological observations were made during the experiments. Dr. Miller's investigations prove that the velocity of the explosive sound at a distance of 100 feet from a 10-inch gun is about 1,240 feet per second, or 22 per cent above normal. At 200 feet it is only about 5 per cent above normal. For all distance above 500 feet the velocity of the sounds produced by the largest sized gun is practically normal.

## CONDITIONS FOR THE $5,000 PRIZE EINSTEIN ESSAY CONTEST

1. No essay shall be longer than 3,000 words.

2. All essays must be in English, and written as simply, lucidly and non-technically as possible.

3. Each essay must be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted.

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The Committee of Judges will consist of Professors Leigh Page of Yale and E. P. Adams of Princeton. In the event that they are unable to agree on the best essay, the Einstein Prize Essay Editor will cast the deciding vote.

## Aeronautics

**Aerial Transport in Kongo.**—A dispatch from Brussels says that the mission charged with organizing aerial transport in Kongo, Africa, is actively continuing its work. The first hydro-airplane flight took place some time ago between Kinshasa and Bolobo. Belgian aviators covered a distance of 200 miles in a little over two and a half hours.

**A New High-Lift Wing** known as the "Aulula" wing is now attracting wide attention among British airmen. The wing is the result of some eight or nine years' patient research work on small-scale and full-scale models. All these experiments have been directed toward producing a wing with high lifting power and low head resistance. It is claimed that the new wing eliminates all "end losses" and leakage which reduce the efficiency of other wings and waste energy in vortices. It is this feature which makes for an enormously high percentage of actual lifting power.

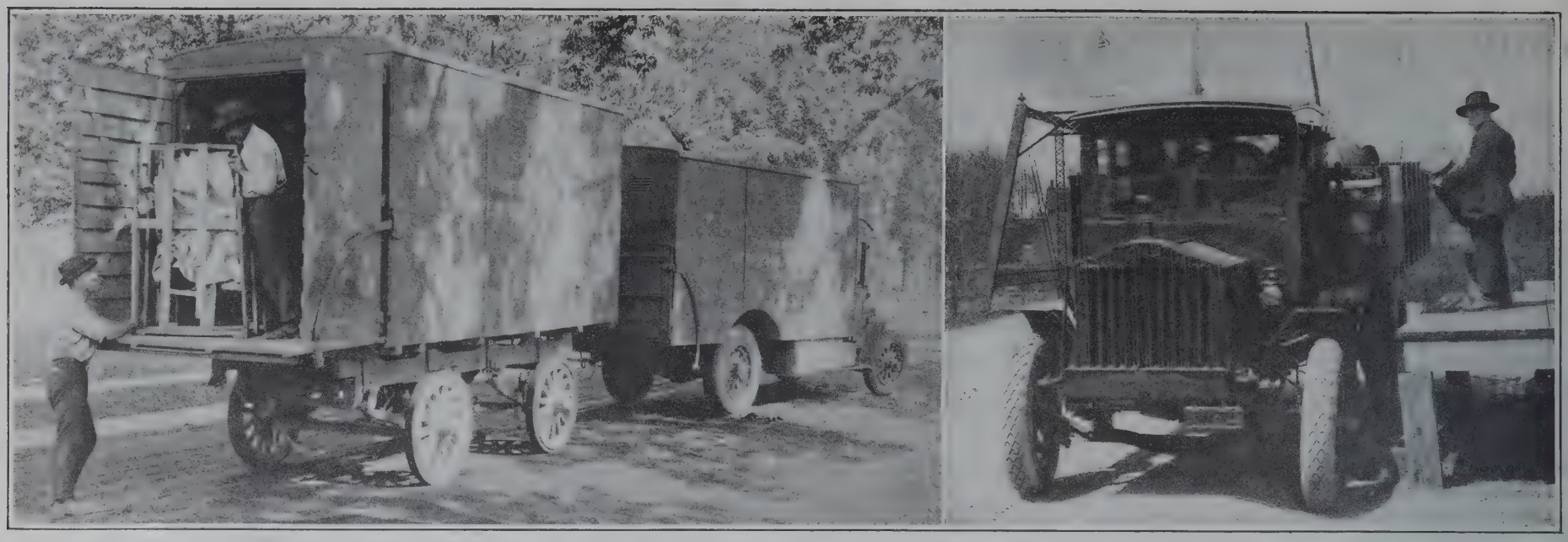
**American-Built Junkers Monoplanes.**—From advertisements which have recently appeared in the aeronautical press, it is learned that the Junkers all-metal monoplane is to be constructed in the United States at an early date. It will be known as the J.L.-6, and built under a patent license granted by Dr. Hugo Junkers of Germany. It is claimed that the machine will carry six to eight passengers at an average speed of 112 miles per hour with a 160-horse-power engine.

**An American Torpedo Plane.**—Carrying a crew of four men and a 1,600-pound torpedo, a Martin bombing plane fitted with torpedo gears recently flew from Washington to Yorktown, Va., a distance of 125 miles, in 64 minutes. Naval officers declare the flight established a record for planes of that type. The flight, continues *Aerial Age Weekly*, was made as a test of the Martin plane in connection with its use in the bombing and torpedo practice soon to be conducted with the old battleship "Indiana" as a target.

**Smoke Screens from Air Bombs.**—Tests conducted by representatives of the Bureau of Ordnance, Navy Department, with smoke bombs designed to lay a smoke screen for naval vessels from aircraft, proved that a satisfactory screen can be laid in this manner. Experimental models of smoke bombs weighing 50 pounds were tested recently, and after the experiments it was agreed that a bomb weighing not less than 100 pounds would prove to be more satisfactory for the purpose for which the experimental models had been designed.

**Timber Land Inspections by Airplane.**—Traveling 200 miles in 144 minutes, part of the time circling low to note the destruction done by forest fires in the Yakima district, Washington, Aviator R. I. Ehrlichman of a local lumber company, accompanied by the vice-president of the company, recently inspected the timber holdings of his organization by airplane. The aerial inspection is reported to be a highly satisfactory means of making a rapid yet sufficiently complete survey of timber holdings.

**Zeppelin Activities.**—A few weeks ago Germany delivered a brand new Zeppelin, the largest yet built, to France and another new Zeppelin to Great Britain. Yet we are told by *The Aeroplane* that Herr Colsmann, the director-general of the Zeppelin interests, recently returned from the United States after negotiating with certain firms regarding transatlantic air traffic. Negotiations have also been carried on with Holland, Sweden, and the United States for the construction of airships on an international basis. It is rumored that a new type Zeppelin airship, with a load capacity of 60 tons, accommodation for 500 passengers and fuel capacity for a voyage three times the length of the Atlantic crossing, is to be evolved.



*Left:* This interurban express line running out of Milwaukee makes use of the truck and trailer system. The service extends as far as Madison and Beaver Dam, and is said to be operating at 100 per cent capacity in picking up and delivering package freight of all kinds to farmers along the route. *Right:* A truck of a Detroit milk company making the rounds of the rural districts. Over half of Detroit's milk supply is now being brought in by motor truck

**Two instances of how the motor truck is filling a very important gap in the Nation's transportation system**

# A New Deal in Transportation

## Relieving the Railroad of the Business Which It Is Least Able to Handle

### By Col. Jesse G. Vincent, Vice-Pres. Packard Motor Car Co.

WE have reached the point where congestion of terminals and tracks has begun to apply the law of diminishing returns to railroad freight traffic. The situation is greatly aggravated by the immense shortage in freight cars. Together, these have brought about a partial failure in our transportation system that is causing great loss—loss to the roads themselves, particularly in short-haul, less-than-carload freight, loss to the shippers, and loss to the general public by reason of the increased cost of living and the impossibility of delivering products promptly at the point where they are needed.

Into this situation the motor truck is coming as a means of salvation. It is only a few years old, and has been fitted for its task even more recently, through the grueling strains suddenly put upon it during the World War. Although it is barely beginning to serve, it has proved itself possessed of the power to save money for the public, the shipper and the railroads at one stroke, besides solving the transportation tangle by lifting the burden which presses most heavily on the railroads, that of short-haul, less-than-carload freight.

A more or less permanent shortage of 100,000 freight cars which has existed for several years back puts additional stress on every discussion of this new movement in the transporting of the country's freight. And little promise is held forth for early relief from this serious freight car shortage. According to *Railway Age*, there will be needed in this country during the next three years, if provision is to be made for the inevitable growth of shipping and the retirement of worn-out equipment, a total of 712,400 new freight cars, not to mention locomotives, signal apparatus, track maintenance material and sundry other rail supplies in similar quantities.

Many trustworthy authorities contend that it will be utterly impossible to construct this large amount of new equipment rapidly enough to satisfy the shipper's needs. Surely, the contention is not far from logical if we may take as a criterion by which future production may be predicted, the freight car output for 1918, computed from statistics of the Railway Administration, which show that during this year deliveries were made on an order for 100,000 new freight cars at the rate of only 61,000 units per year.

The seriousness of the situation and the tremendous cost to both the shippers and to the public are at once apparent. The harmful influences of congestion reach into every producing center in the country. A prompt turn-over of freight is out of the question. Consequently, excessive credits are required to carry the burden of distribution through its cycle. Production is severely crippled through the lack of raw materials and as a direct result of this prices are increased.

All of these things arise from inadequate transportation and must be corrected before the country can return to a normal condition so far as the movement of freight is concerned. Some of this improvement will come naturally through the reorganization of the railroads, but it cannot all come from these quarters. Those who study traffic conditions closely are beginning to realize that no amount of expansion beyond a certain economic point can be of any profit, either to the railroads, to the shippers or to the public. Their deduction is based upon a law that heretofore has not been applied to railroad traffic, being confined solely to production problems. The law is known as the law of diminishing returns.

At first glance, any presumption that the motor truck as a means of moving the country's freight will meet its greatest opportunity after a given section of the country is so thoroughly developed from the railroad standpoint that no further advances are possible, seems grossly inconsistent; but, as a matter of fact, something of this kind is very liable to come about. Judging from conditions as they exist in the crowded eastern and northern States, this law of diminishing returns is beginning to operate.

The industrial section of the country, lying to the north of the Ohio River and extending eastward to the Atlantic, has been described as being literally nothing more than a huge switch yard in which the routine of keeping freight moving rapidly and of administering the countless details of short hauls and numerous transfers or trans-shipments, is becoming more and more difficult as time goes on. In this part of the country, a railroad report for a month in 1917 showed, under the stress of war-time production, the average daily freight our mileage of 25 miles was reduced to but 18 miles.

Undoubtedly there is a certain point in the expansion of railroads where such a penalty is paid. Obviously it does not apply to all localities, but there is no question but that it does find favorable soil in the crowded north-east territory, where the railroad has had the greatest growth in answer to the ever increasing industrial growth of the surrounding country.

The most significant fact of all is that so far as transportation experts can see at the present time, the law of diminishing returns creates a permanent barrier which the railroads will never, for simply physical reasons, be able to surmount. The more the trackage and the larger the number of terminals, the more the congestion will be aggravated and the slower the movement of freight will be.

So far as the money-making ability of the railroads goes, it will not be hampered in the least by a far wider adoption of motor trucks; for these motor trucks in practically every instance will be handling freight which could not be accepted at a profit by the railroads.

For many years, less-than-carload freight has been a skeleton in the railroads' closet and a very real cloud over the profit and loss sheets. Less-than-carload freight has never been catered to by the railroads. They have never been slow to realize the impossibility of securing an adequate profit on shipments which involve one or more transfers, with trucking and handling charges incidental thereto, before delivery to the consignee can be made.

Profits to the railroads come from long, uninterrupted hauls, such as those far-sighted pioneers of the Hill and Harriman school prepared for when they laid lines through the desert wastes of the West to reach the active Pacific Coast region.

One very definite advantage that will come to the railroads themselves through the increased use of trucks in handling short-haul freight, will be in connection with what are known as "feeders." These short lines are almost all of them unprofitable and many are able to subsist only through charging extremely high freight rates. They are intended for no other purpose than to bring in, to the trunk lines, freight that will prove profitable on long hauls; and this long haul freight, therefore, has to bear the burden of an actual loss to cover transportation over the "feeders."

Truck lines will almost certainly in due time take the place of the "feeder" roads with benefit to all concerned. They will, in almost every case, reduce the cost of freight and they will give a more flexible service. They also are infinitely below the cost of even the lightest branch railway for installation and they can be put in at thousands of points where it

(*Continued on page 389*)

*ONE of the most satisfying things about the progress of applied science is the way it has of always producing, as though from a conjurer's hat, the exact appliance that civilization needs at just the moment when the need appears. History is full of the stories of sudden developments of new inventions in a way that appears almost miraculous until a study of conditions shows that the world was exactly ready and waiting for the particular invention in question. We are today witnessing the beginning of just such a development in the transportation field, in the entrance of the motor truck into the short-haul business. This is a story that is more or less familiar to most of us, but few of us will fail to find food for reflection in Col. Vincent's treatment.*
—THE EDITOR.

## Applying Radium to Cure Man's Ills

By H. A. Mount

THERE has been much popular interest recently in the purchase by the State of New York of two and a quarter grams of radium for use in medical research work. Aside from being the largest single transaction in the precious material ever recorded, the sale price being $225,000, the incident holds a vital interest to thousands of sufferers from cancer and other malignant diseases, for the radium is to be used largely in fighting this dreaded malady.

Every year in the United States approximately ninety thousand persons die of cancer, the second disease in deadliness. Radium has long been used successfully in fighting cancer and similar malignant conditions, such as tumors, and for treating growths of a benign nature, including the removal of birthmarks. Radium has also been used in the treatment of rheumatism and neuralgia and for diseases of the kidneys and liver and certain disorderly conditions of the digestive tract.

At the left is the lead case in which the radium is carried. Below is a plaque for applying radium to skin and surface afflictions. The round disks are metal screens. At the right is an applicator, dissembled, with screens. At the extreme right the insertion of an applicator into a screen is shown

**How the medical profession makes use of radium as a tool in curing human ills**

The interest of the ordinary individual in radium is matched by a profound ignorance of how it is used in medicine and perhaps a brief exposition of methods will not be amiss at this time. There is nothing particularly new in the facts recorded here. The man who wishes to go more deeply into the subject will find many books on the therapeutics of radium in the libraries. There has been no important widening of the field of usefulness of radium in medicine in recent years, but the technique of its use has improved wonderfully and the results today are far more valuable than a few years ago. It is in this connection that the purchase by New York State is expected to be of especial value.

Radium, as used in the hospital, is not a medicine or a "cure." It is a tool—just as much a tool as the surgeon's knife; and it requires just as much skill and knowledge to use it successfully.

It is a matter of common scientific knowledge that radium emits three kinds of "rays," designated as Alpha, Beta and Gamma rays. The Alpha rays, which compose about 85 per cent of the total, have very little penetration. A sheet of tissue paper will stop them. The Beta rays, composing 10 per cent of the total, will penetrate about 35 millimeters of lead. Both of these are not really "rays," but emanations from the radium itself. They are tiny particles shot out at terrific speed and force, the fastest traveling at about one-fifteenth the speed of light. The third "ray," the Gamma, is really a "ray" or vibration similar in action and effect to the X-ray, excepting that the wave is shorter and "harder." It travels with about the speed of light. It is this Gamma ray which is useful in surgery.

It has been found that this ray has the effect of destroying, or dissolving, useless tissue exposed to it. Good tissue has a much greater resistance to its effects, usually being about a fourth as susceptible to the rays as useless tissue. After the first exposure to the rays, even useless tissue, however, builds up a resistance to the effects. It is the object of the physician, therefore, to expose the part to be treated to a maximum intensity for the longest time possible without affecting the good tissue.

There is no pain or other effect immediately noticeable from the exposure. But if the treatment has been effective, the growth will gradually disappear in time which may vary from a few weeks to several months, depending upon the nature of the growth and the physical condition of the patient. Subsequent exposures may be made but the first is depended upon to accomplish the principal result.

By means of the electroscope it is possible to measure to a very fine degree the strength of the radium "rays." The rays, of course, are always constant and this represents a distinct advantage over X-rays, which may fluctuate in volume.

The amount of the "dose" can be accurately gaged by determining the size and location of the tissue to be treated, the distance from the spot the radium is to be held, and the nature and thickness of "screens" which are placed between the radium and the flesh.

The usual method of application is to place the little

(Continued on page 390)

## Putting Paper on a Specification Basis

By G. H. Dacy

AT present the paper question is one of the paramount issues of the day with the most critical news print shortage ever experienced. Everywhere throughout the country advertising is being curtailed to the minimum point while all news material which is not of vital importance is being reduced to the smallest possible space in order that the available paper stocks may be conserved. In view of the paper economy campaign which is being preached and practised rigorously and well, the official data determined by the Federal Government in its various paper making and handling operations are of special interest at this time.

Annually the various government departments use approximately 50,000 tons of paper and in order to insure that this huge volume of paper corresponds in every respect to the specifications according to which it was purchased, Uncle Sam submits the stocks to many scientific and accurate efficiency tests. The paper is subjected to many physical and chemical tests as well as micro-analysis.

By means of the chemical tests it is possible to ascertain accurately the amount of resin sizing that is in the paper and the amount of filler and loading which has been added to give the paper bulk, capacity, finish and surface. The physical tests permit of determining definitely the weight, thickness and bursting strength as well as the folding endurance and tensile strength of each variety of paper which is tested. Last year, the Bureau of Standards, which performs the paper testing activities for the Federal Government, subjected 5,000 samples of paper to 19,545 official tests.

The "sizing" of the paper is the property which makes it possible to write upon it with ink. The methods now in use for determining the sizing of paper stock are not very satisfactory from a laboratory or mill-control standpoint and, on this account, Uncle Sam's scientists are now busy trying to devise more satisfactory tests. Furthermore all the available apparatus for ascertaining the bursting, tearing and tensile strength of paper are under investigation by careful and experienced experts so that they may, as far as possible, standardize the paper testing situation.

The Bureau of Standards has installed a miniature but complete paper mill on which it has tested out various fibers, weeds and grasses for paper making. The indications are, from the results thus far obtained, that wood pulp is the most dependable source of paper as various economical factors operate in one way or

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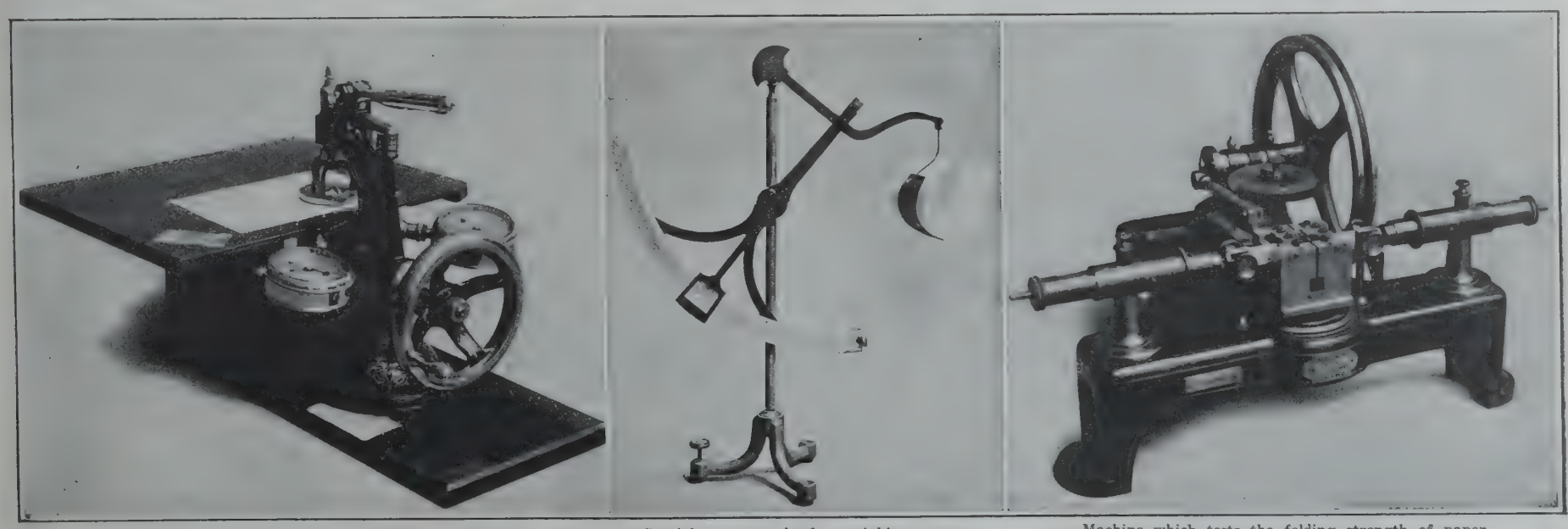


This machine is invaluable for testing bursting strength of paper

Special paper scale for weighing paper

Machine which tests the folding strength of paper

**Three machines which serve to check up on the printing quality and wearing properties of paper**

# What About Our Wheat Production?

## A Concrete Suggestion as to How We May Produce More by Producing Less

By H. A. Crafts

THESE are times that demand the consideration of vital questions only. And at this time, as always, there is a paramount vital question.

What is the paramount vital question of today? It is not war, because wars of any great magnitude are over for many years to come. Wars being over, peace comes automatically, regardless of diplomacy or parliamentarism.

The Great War has been over for nearly two years now, and parliaments and peace conferences have been laboring night and day at the framing up of a paper peace, yet they have so far failed to reach an agreement that they have been able to put into effect. Yet comparative peace reigns throughout the world today. And here we have a shining example of the superiority of physical forces to moral forces.

If we search a little we shall discover that our paramount vital issue lies, not within the realm of politics, but within the domain of economics. And within the domain of economics we find the matter of human subsistence looming above all others.

The world's food supply must be the first great problem to be solved. If the law of supply and demand still endures in the commercial world the very high cost of living of today should go to prove that the world's food supply is far below the normal demand. In our own country there exists a condition of apparent plenty, yet food prices are exceedingly high. In Europe incipient famine and exorbitant food prices go hand in hand.

What are the chances of overcoming this overshadowing world menace? It is very probable that we have not acquired an adequate conception of the frightful condition of physical, moral and financial exhaustion that Europe was left in at the time of the signing of the armistice. And even Europe's remaining strength is being taxed by revolutions, and counter revolutions. Even in pre-war times Europe fell far short of producing her own food supply; then how much less able is she today to feed her own people than before the fateful day of August 4th, 1914!

Upon whom then will fall the burden of making up this appalling deficiency in the world's food supply? Upon us of the United States, and upon almost none other. We have already sustained enormous sacrifices in stricken Europe's behalf, yet the end is not. We must go on, and on in this work of world philanthropy; yet at the same time we must safeguard our own interest.

Europe saw fit to plunge headlong into a fratricidal conflict, and must expect to suffer the awful consequences of her mistake; yet we must not stand aloof and see her utterly perish, and the innocent suffer the pangs of hunger. Then how about our own ability to cope with this vast and vital problem?

The whole onus lies with the American farmer. The individual farmer may do much of his own volition. But it appears to me to be more a question of farm policy. New cultural methods may be introduced and be of large value. But more important than all is general enlightenment, coördination of economic and intellectual forces, and coöperation in the field of general effort.

The American farmer has various obstacles in his way, among which are a shortage of farm help, antiquated methods, and soil impoverishment. On the other hand a careful survey of conditions will show that there are certain phases of the industry that are of an encouraging nature.

One of these is the invention and introduction of an entirely new order of farm machinery; the general supplementing of animal power by gas power, etc. Such a power has already begun, and is working with a tremendous impulse. Its possibilities rise before the mind's eye to stupendous heights.

But of equal, if not of more, importance is the refertilization of our cultivated farm areas, which for the past half century have been drawn upon almost without limit, with no compensating return to the soil of fertilizing material. How is this to be done? The use of stable manure, commercial fertilizers, or of any other class of ordinary fertilizer, is out of the question. These materials as fertilizers are on a par with the old farm horse and plow, as compared with a modern farm tractor. We must get back to nature.

What are the elements that make fertile our virgin forest clearings, our plains and delta lands? Why, the falling leaf, the withering grass, and the profuse rootage of growing forests and verdant plains, forming that element we call the turf, and these in their decayed or incinerated state.

Why do not our forests languish and our plains become sandy deserts? Because in Nature's great system of economy they manure themselves with their own substances.

But of course there are other aids to natural growth; the sunshine, the wind, the rain, and various other phenomena. All of these are also available for the nourishment of cultivated growing crops. Therefore it is the farmer's duty to follow the example of Nature, and make his land manure itself.

This must be done by methods already known to most farmers, and practised by many. The art of green manuring, and of the scientific rotation of crops, to my thinking may be easily made to bring about the solution of this most momentous problem.

To emphasize the stern necessity of instituting this reform in our agricultural methods it is only necessary to cite the history of a single cereal—wheat. Wheat as the world's principal bread material had its acid test in the recent food shortage in Europe. We gave up a portion of our white bread, and ate various kinds of war bread, that our allies across the water might not be deprived of their wheat bread. We swallowed it with Spartan hardihood—this war bread, part barley, or rye, or corn, or rice, but when the old pure white loaf came back again it filled our hearts with rejoicing.

*THE exhaustion of the world's wheat fields and the moving of the wheat grower on to new territory is an old story. But it seems that he cannot move on forever without coming to a jumping-off place; and the performance of the past few years would indicate that just at a moment when the world's need for bumper wheat crops is most acute, this jumping-off place comes in evidence. It is therefore in order to ask what else we can do, to increase wheat production, than abandon the old fields and pass on to new. One answer may lie in the direction of farming on a sufficiently intelligent basis to prevent the soil from being exhausted of the elements that make for wheat production. Mr. Crafts puts forward two very concrete suggestions as to how this might be done, and at the same time makes properly clear the general principle on which both these suggestions rest.*—THE EDITOR.

Wheat is the premier bread cereal of the world, and stands today fixed and firm upon its economic pedestal. What is the United States doing in the way of producing this supreme bread material?

It is not the aggregate yield of the country that we must look at, but rather the yield per acre. Under war urgency the country produced about one billion bushels of wheat in 1918. But if the yield per acre for that year were sought it would doubtless make a poorer showing than in any year in the country's recent history. In California, for instance, there were thousands of acres sown to wheat that produced no harvest at all, by reason of severe drouth. And these acres must be counted in when we come to reckon the average yield per acre; for it is the number of acres sown that must be taken as the basis of reckoning, and not the number of acres harvested.

Then let us take the country's wheat crop of 1916 as being the nearest to normal. The acreage is given as 52,785,000; total yield, 639,886,000 bushels; average yield per acre 12.1 bushels. This places the United States even below reactionary Russia in its average wheat yield per acre, a sad commentary upon the progressiveness of our country, supposed to be the most progressive in the world.

But when we take up the cases of individual States the showing is even worse. Let us consider the average yields of wheat per acre of some of the supposed great wheat producing States for 1916: North Dawota, 5.5 bushels; Minnesota, 7.4 bushels; South Dakota, 6.8; Kansas, 12; Missouri, 8.5; and so on.

The States showing the best yields of wheat for that year, strange to say, were come of those New England and Middle States, whose agriculture is supposed to be in a moribund condition. Maine's average yield per acre was 27 bushels; Vermont's, 25 bushels; New Jersey's, 20 bushels; New York's, 21 bushels. So it seems that the culpability, if such it be, lies with the great West, supposed to be the store-house of the nation. And all this is due to an almost total disregard for one of the great fundamental principles of sound agriculture—refertilization. How about the remedy for this menacing evil?

Two examples that have come under my personal observation will suffice as finger-boards, pointing the way to reform in our agricultural methods.

For a period of twenty-three years I was a resident of northern Colorado, and observed quite closely the evolution of farming methods in that section. First there developed a great system of irrigation, which, coupled with an extremely fertile soil, opened a rich field for agricultural enterprise. At first the almost universal crop raised was wheat; because there was a great mining state round about which was drawing a large influx of settlers from all over the world, demanding a commensurate food supply. Railroad tariffs from the Missouri River were high, and this acted as a protection to the Colorado farmers. Colorado wheat struck a level of two cents per pound, and maintained it for a number of years.

The new lands, under the combined influence of fertile soils, ample water supply and a favorable climate produced wonderful crops of wheat—say from forty to sixty bushels to the acre. The farmers got rich. But they made the fatal mistake of following a course of blind opportunism. They sowed their fields to wheat year after year, with no rest, no manuring, no rotation of crops. The yield of wheat per acre dwindled from year to year until the average was only about eighteen bushels to the acre.

Meantime competing lines of railroad flung their tracks of steel across the great plains and railroad freight rates melted away beneath the hammering of rival lines. Wheat fell to a cent and a quarter per pound, and the farmers got poor. Some "pulled up stakes," and pushed on over the divide to Oregon; others stuck it out. Then the question arose as to what the Colorado farmers could raise, and make a profit.

A certain dealer in flour, feed and seed in Fort Collins had heard about alfalfa and its wonderful properties as a forage crop. So he sent to Los Angeles for a sack of alfalfa seed. It happened that this dealer was the owner of a ranch near town, and there he took his sack of alfalfa seed, and tried it out on his own account. It produced beyond anything that he had dreamed of.

His fellow ranchers, without knowing just how they could dispose of alfalfa at a profit, even should they produce it, began to plow up their run-out wheat fields and sowing them to the new forage plant. In a few years the country round about became green with alfalfa verdure, and literally loaded with alfalfa hay in barn and stack. But there was no special demand for the product, so the farmers began to plow under their alfalfa and to try wheat once more.

And behold! The wheat produced unexpected stands; in fact it grew so rank that it "lodged," or "fell down," to use some common farm phrases. So the farmers were compelled to plant some less susceptible crop on their alfalfa lands for a year or two; such crops as potatoes, sugar beets. Then wheat was tried again and it went back to the old virgin yields, and some better.

Naturally it became the desire to continue the growing of a crop that would produce from seven to nine tons of hay to the acre in a single season and at the same time enrich the land upon which it was grown.

By a mere accident again a way was discovered—the feeding of spring lambs from the ranges, for the Chicago market, upon alfalfa hay and corn shipped in from Kansas and Nebraska. Here was an entirely new industry that soon grew to large proportions, it being no uncommon thing to see half a million head of lambs fed around a single farming section in a single season.

(*Continued on page 391*)

# Why We Need a Separate Trade-Mark Bureau

## Growth in Use and Popularity That Demand a Greater Degree of Specialized Federal Oversight

By Chauncey P. Carter

IT is a fact little appreciated by those most interested that patents are granted by virtue of a specific constitutional provision authorizing Congress to secure "for limited times to authors and inventors the exclusive right to their respective writings and discoveries," while the right to exclusive use of a particular trade-mark is acquired by use, is unlimited in duration and is of interest to and may be registered by the Federal Government only if such use extends into interstate or foreign commerce and thus brings the mark into the purview of another constitutional provision giving Congress general authority over interstate and foreign commerce.

Patent rights and copyrights, therefore, are obtained by virtue of contracts between the inventors or authors and the Government wherein the former agree to disclose and do disclose their discoveries or writings in return for the grant of and protection in the exclusive right therein for a limited period after which they shall become public property.

The exclusive right to use a certain trade-mark to identify a certain kind of goods, on the other hand, is not granted by the Government in this country, but is acquired as a result of original use of such mark in connection with those goods just as a newsboy as a result of having been the first to do so, acquires an unwritten right to sell his papers on a certain corner, undisturbed by others. This is true not only in the United States, but also in England and in practically all countries where there is a "common law" consisting of court decisions as distinguished from those countries that are governed entirely by an approved code of laws and known as "code" countries. In most of the "code" countries, the right to the exclusive use of a particular trade-mark in connection with certain goods is not acquired by original use but must be obtained from the Government, which usually grants the same to the first applicant therefor, regardless of earlier use by another without such grant. In fact, it is a punishable offense in some "code" countries to use a trade-mark that has not been legally granted to the user.

Aside from these "code" countries, however, it will be seen that there is a fundamental difference between patent- and copy-rights on the one hand and trade-mark rights on the other hand, and even in the "code" countries this distinction is made: patent- and copy-rights are limited in duration, while trade-mark rights are unlimited in duration although they are often subject to annual taxes or renewals for revenue purposes and to avoid "sleeping on one's rights."

Notwithstanding this fundamental difference, it seemed wise to certain of our early legislators to place the registration of claims for rights to exclusive use of trade-marks in interstate and foreign commerce in the same hands as had been placed the grant of patents. It is not at all improbable that this was a result of a misapprehension in the minds of these early legislators that the rights were fundamentally similar. Indeed, the first law providing for the Federal registration of trade-marks was soon after its enactment declared unconstitutional, because it was not limited to marks used in interstate or foreign commerce and, therefore, had no place to hang its hat in the Constitution.

However that may be, the Federal registration of trade-marks has always been and is still with the Patent Office. The proposed breaking up of the Department of the Interior and the substitution for it of a Department of Public Works bids fair to become an accomplished fact in the not too distant future. be accompanied by a giving up of the Patent Office to the Department of Commerce as a sort of "swap" for the Bureau of Standards. It therefore seems proper to inquire whether this "swap" might not well be accompanied by a breaking up of the Patent Office into two parts, one to grant patents and the other to register claims to rights in trade-marks, labels and prints. Such an inquiry would seem to be justified in any case by the great increase in the number of trade-mark registrations that has taken place since this task was entrusted to the Patent Office and by a comparison between the numbers of patents and trade-mark certificates issued then and now.

In the Report of the Commissioner of Patents to Congress for the year ended December 31, 1918, it is stated that trade-mark certificates were first issued in 1870 when there were 121 of them as compared with 13,333 letters patent during the same year. As compared with this, the Report of the Commissioner of Patents to the Secretary of the Interior for the fiscal year ended June 30, 1919, indicates that in that fiscal year 3,766 trade-mark certificates were issued as against 37,259 Letters Patent. In other words, there has been an increase of over 3,000 per cent in the registration of trade-marks as compared with an increase of less than 200 per cent in letters patent. Moreover, while of the patents and trade-mark certificates issued in 1870, trade-mark certificates formed less than one per cent, in 1919 they formed approximately ten per cent. In the fiscal year 1915, the year in which the majority of applications filed prior to the outbreak of the war were finally acted upon, the trade-mark certificates issued compared even more favorably with patents than in 1919.

Despite these facts, and despite the great difference between the merchandizing field, in which advertising and selling depend so heavily upon trade-marks, and the engineering and industrial field, in which patent rights are of such great importance, it is a fact still that one man, the under-salaried Commissioner of Patents, has the last word this side of the courts in both patent and trade-mark matters. Hence, it is not at all unusual, but is rather to be expected, that the Commissioner in a single morning shall be called upon to decide whether there is any invention in a device for

(*Continued on page 391*)

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

## Ventilation of the Hudson River Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

Readily admitting the necessity of vehicle tunnels under the Hudson River at Canal Street, there is the great importance of proper and ample ventilation without which the tunnels would be useless. The greater number of vehicles, probably 90 per cent, will be automobiles and motor trucks, exhaling poisonous gases. On this point the *Literary Digest* for August contains a very instructive article. It concludes with the warning that the contents of carbon monoxide (the most poisonous gas contained in the exhalations of motor vehicles) must not exceed the maximum of four parts in ten thousand parts of air. This conclusion has the endorsement of the United States Bureau of Mines, but the solution of the problem is left to the engineers of the Commission.

Although a novel problem, the principle of it is simple and easily understood. Fresh air enters through holes short distances apart from a fresh air duct, running the entire length of the tunnel. The amount of fresh air must be sufficient to dilute the poisonous gases at the required rate. Another duct, also running the entire length of the tunnel and also connecting with the tunnel through numerous holes, sucks up the contaminated air which is expelled through shafts at each end by mechanical blowers. The ventilation is thus crosswise to the tunnel and is a continuous operation that requires careful designing for its success.

Let us believe that the engineers of the Commission have thoroughly studied the problem, yet it is of such overwhelming importance that the details of that study should be published as proof thereof.

To mention only one point. The velocity of air and gases through the ducts will be very great. The friction along the walls of the duct and through the orifices will consume a great deal of power, which will increase rapidly as the walls of the ducts will become rough and incrustated from the dirt and dust in the air. The surfaces of the ducts will therefore require periodic inspection and cleaning similarly as chimneys require periodic cleaning from soot. To that end the height of the ducts should be sufficient for a man to walk through from end to end, 4,000 feet long. But the heights shown in the plans are only from one foot to four and one-half feet in the lower duct and from one foot to five feet in the upper duct. These heights are too low and would require continuous stooping of the workmen, which is both exhausting and tormenting in long, hot ducts. The upper grating seems hardly strong enough to bear the weight of any mechanical device or track for removing the dust.

Why is the fresh air duct placed at the bottom? Air coming up from the bottom will mix before being inhaled with the hot poisonous gases, which are expelled at the bottom of motor vehicles. If the cool, pure air is admitted at the top then it can be inhaled *before* it mixes with the foul hot gases at the bottom, which should be instantly sucked up.

For the ducts to be sufficiently large, the diameter of tunnel should be increased from 29 feet to 32 feet. That would also give more width for the roadway and sidewalk and contribute to greater safety of workmen and policemen employed in the tunnel.

No shortsighted economy should expose the users of the tunnel to poisoning by insufficient ventilation. On this point the details of operation cannot be too specific and should be published. The Commission by meeting this justified request at this time would invite public confidence just when it is most needed for the referendum vote, authorizing the bonds to be issued for this work, which not unjustly is regarded as a huge and costly experiment.

MECHANICAL ENGINEER.

## Wicker Weaving by Machine

To the Editor of the SCIENTIFIC AMERICAN:

Your issue of March 6th containing an article under the above title has been brought to the writer's attention. You have supplemented this article with editorial comments to the effect that the art of wicker weaving has been revolutionized. Evidently you are not aware of the fact that in spite of the invention you describe, wicker baby carriages are still woven exclusively by hand. In other words, the machine which you describe does not weave wicker but weaves an imitation of reed. Reed comes in strands about twenty feet long. The machine you describe feeds from a spool, and the writer has never yet seen a piece of material woven by this machine that was not made of fiber (twisted paper).

So the old art of weaving reed is hardly influenced by this machine. In order to be satisfied with a machine-woven carriage, the mother must be satisfied with a paper imitation of reed, and also must be satisfied with a monotonous sameness of design, as all of those scrolls, festoons and various designs which have been originated by reed workers to delight the eyes of the mother are impossible in the machine-woven carriage.

I have supplied these details for your information. At the same time I have had enough experience as an advertising man to realize that some press agent is entitled to congratulations on his success.

Elkhart, Ind. A. H. LORD.

## The Dendrograph

To the Editor of the SCIENTIFIC AMERICAN:

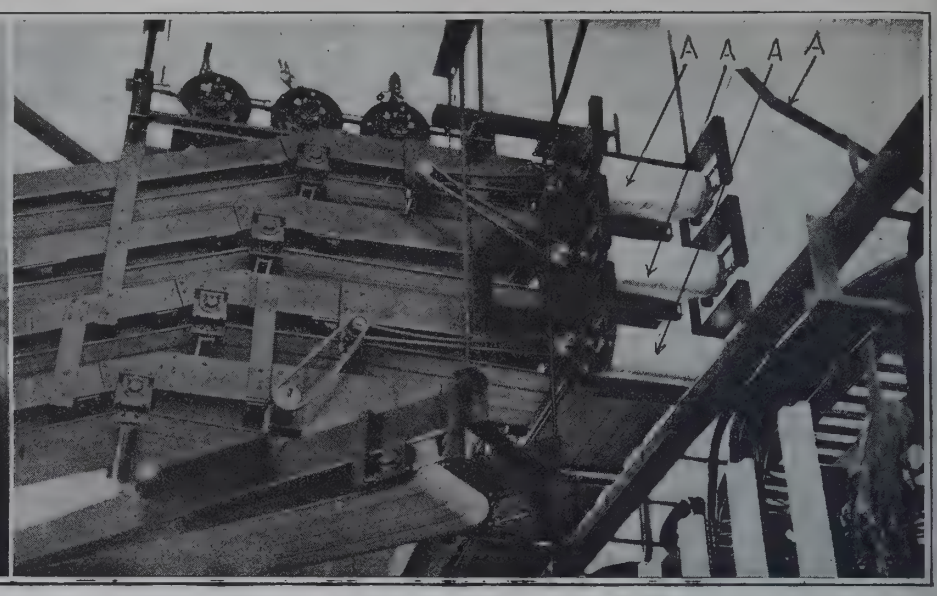
Referring to my description of the dendrograph in operation at the New York Botanical Garden published in the SCIENTIFIC AMERICAN for May 29, 1920, I will say that the article was written without due authorization.

Dr. D. T. MacDougal of the Carnegie Institution of Washington, the designer, placed this working model in the hands of Dr. A. B. Stout of the New York Botanical Garden for testing, with the privilege of describing the seasonal growth of the tree to which it was attached in the Journal of the Garden.

The Department of Botanical Research of the Carnegie Institution of Washington proposes to defer publication of a technical description of the instrument until it has been perfected by the aid of results secured from trials now being conducted by collaborators in various parts of the country. W. A. MURRILL.

New York.

A corner of the receiving department, showing the automatic receiving machines and manner in which even the incoming messages are distributed by conveyor




A detail of the conveyor mechanism, making clear the manner in which the belts are able to negotiate a right-angled turn without losing their messages

# Twentieth Century Telegraphy

## The Big San Francisco Central Office, the Last Word in Equipment for Speed and Capacity

By Charles W. Geiger

WHAT is said to be the best equipped telegraph office in the world was recently placed in operation by the Western Union at San Francisco. Here all the innovations that experience has found to be desirable have been embodied and all features that experience has found to be undesirable have been eliminated. Standardization is now being carried to a point in the design and operation of these telegraph offices seldom seen in any industry.

The San Francisco office, which is the third largest in point of business transacted in the entire United States, handles approximately 2,500,000 messages per month, and due to the modern equipment and efficiency of operation, at least 2,400,000 of these messages are disposed of within ten minutes from the time they are received at the office.

The most striking feature of the new office, aside from the electrical and mechanical improvements, is the comprehensive system of automatic belt carriers which convey the telegrams to and from all parts of the great room. Thus, the greatest economy of time is effected in the handling of messages from the time they are received until they are on the wires.

This system consists of especially designed enclosed belt conveyors in front of every operator, along the center of the tables, conveying all messages entering the room to a central distributing center in a series of flumes.

Messages are received over the multiplex, the Morse, the telephone and by a pneumatic tube system leaving the city branch offices. The messages from these four sources are placed on the belt conveyors, which quickly deliver them to a slower moving belt in front of a line of young women, who sort them and place them on one of the four belt conveyors (according to their destination), to be conveyed to the transmitting operators. The maximum time in transit for messages around the room (which has an area of 10,000 sq. ft.) by means of these conveyors is 54 seconds with an average of 21 seconds.

A very ingenious method has been employed in carrying the conveyors across the main isle. This is done by double belts, both rising, and clasping the messages between them. This method is also employed in delivering the messages from the telephone room which is located on the floor below the main operating room.

The belt conveyors travel 250 feet per minute, each belt being driven by its individual motor. In order to guard against the delay of a message in passing over these conveyors, two men are employed whose only duty consists in constantly going around the room, stopping each belt in turn for a few seconds, lifting it up, looking under it to see that no message has slipped out of place, testing it to see that it runs freely and then starting it again. As a further precaution, mirrors have been arranged for inspecting the elevated sections of the belt system.

By means of the multiplex, messages are being exchanged between San Francisco and New York within ten minutes every day. The messages are almost literally geared to the inexorable time schedule from the moment they enter the operating room until they have found the proper wires and their transmission has been completed. It is not merely possible but frequent that a telegram is filed at a branch office at San Francisco and received in New York within fifteen minutes. Over shorter distances—say, one thousand miles—the time averages much less, and seven minutes is the average time required for clearing messages to Los Angeles.

It is hardly possible to describe the multiplex system briefly yet satisfactorily. It is based on the idea of an automatic distribution or apportionment of the use of a single wire at intervals, to eight automatic machines, each busily engaged in sending a different message.

The intervals are so rapid that each machine transmits its impulse over the circuit to a corresponding receiving machine, and its turn comes again after the cycle has been completed, in time for it to pick up and send the next impulse without any apparent hesitation. All the impulses are, of course, of equal

(*Continued from page 392*)

General view of the San Francisco main telegraph office, showing (A, A) the conveyor flumes that carry all incoming messages to the distributing center, and out again to the proper operator

## Making Sure of the Concrete Batch

A FIELD equipment for testing crushed stone and sand and clay aggregates, compact, light and capable of withstanding a certain amount of rough usage, has been developed by the United States Bureau of Public Roads, and is proving of great value, both in the plant and in the field or wherever aggregates must be tested for control work in construction and especially in inspection of highway materials.

A factor which probably tends more than any other to discourage adequate control testing of highway materials is the time usually required to send samples to a laboratory for test purposes. Even under the most favorable conditions several days may elapse before a report can be secured, during which time the lot of material represented by the sample must be held. Aggregates always are subject to variations in size, due to inefficiency in plant screenings and other causes, and yet may be intended for use in construction requiring uniformly graded aggregates.

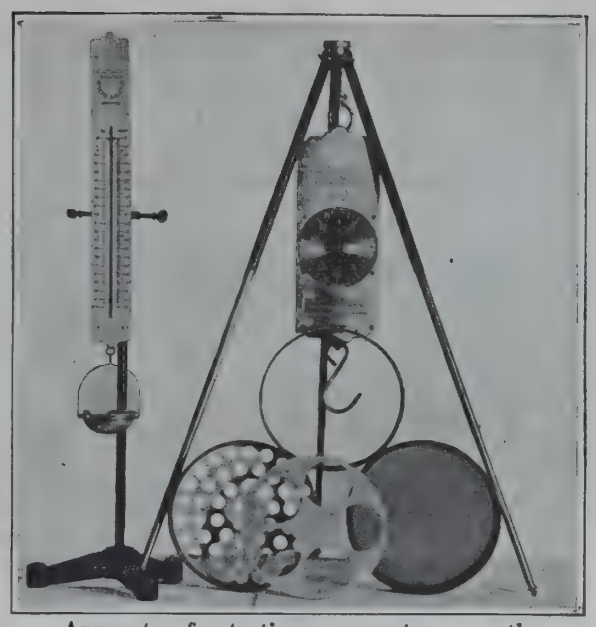
The field equipment consists of a set of interchangeable stone-screens, with screen plates having perforations, 3, 2½, 2, 1½, 1, ¾, ½, and ¼ inches in diameter; a set of interchangeable sand sieves of 10, 20, 30, 40, 50, 80, 100 and 200 mesh; a circular spring scale having a capacity of 30 pounds and sensitive to 0.1 of a pound; a straight spring balance having a capacity of 30 pounds and sensitive to 0.1 of a pound; a straight spring balance having a capacity of 200 grams and sensitive to 1 gram; a demountable cubic-foot box; an ordinary camera-folding tripod; a 250-cubic-centimeter graduate; a strip of screen wire about 22 inches in length and 5 inches high, and two canvas bags about 18 by 18 inches in size.

The interchangeable screen set consists of a number of perforated screen plates 8 inches in diameter, and two brass rings, one of which is provided with a narrow shoulder on the inside upon which a screen plate may be placed. The two rings are firmly clamped together so that the screen plate is held rigidly between them. This forms a screen of the same size and shape as the ordinary laboratory type.

The sand sieves are of the same general type as the screens, the various sieve plates fitting into the brass rings in the same manner. A sieve of any desired mesh may be made up by simply inserting the proper sieve plate in the lower ring and clamping it down by means of the upper ring.

The circular screen scale is supported by the tripod. The graduate is the only piece of glass in the outfit and is needed only when it is desired to make volumetric silt determinations. The circular loop of screen wire is used for making apparent specific gravity determinations of coarse aggregates. The strip is to increase the capacity of the screen, so that it may be used for weighing samples of sufficient size for this determination. It is rolled in the form of a loop and placed inside of the screen ring which in turn is suspended from the spring scales by means of three light wires.

The importance of the proper sampling of material in connection with the testing of aggregates cannot be over-emphasized. There are two points which must be borne in mind when sampling crushed stone and gravel aggregate. First, the sample must be representative of the entire quantity being examined; and second, it must be large enough so that the largest individual piece will in no case weigh more than 2 per cent of the weight of the entire sample.—By *R. Franklin Mundorff.*



**Apparatus for testing aggregates, recently developed by the U. S. Bureau of Public Roads**

## Binder Twine from Florida

WITH more than 200,000,000 pounds of binder twine being used annually to harvest wheat, oats, rye and barley in the United States, a company in Florida has begun the cultivation of sisal and henequen fibers as a source of home supply, the product heretofore being imported from Yucatan. The American farmer expends approximately $20,000,000 for the twine used in tying into bundles about 100,000,000 acres of small grain yearly.

Previous attempts to grow binder-twine fiber in the United States have been unsuccessful. The Florida enterprise, however, is assured a fruition of its plans by 1922. The first crop, necessitating the cultivation of 1,000 acres, was begun in 1917, five years being required to grow the first crop. Southern Florida is the only place in this country where climate and soil are such as to encourage growth of the fiber-producing plants.

Sisal is a tropical plant, the maintenance of which cannot be insured where the temperature falls to the freezing point at any time, 50 degrees being preferable. The lowest temperature in Yucatan is 48 degrees. Among the soil requisites are a porous limestone land, and adequate drainage. For profitable results it should be grown on a plantation of at least 1,000 acres. It is estimated that the first crop in Florida will require a capital of $100,000 before it is brought to fruition. This computation includes cost of machinery, land and the clearing of the virgin territory. The Florida enterprise has acquired several thousand acres of land, located in the southern portion of the Everglades, in Dale County.

This country is threatened with a shortage of binder twine due to the two-fold factor of a decreased price of the product with the resultant effect of a decreased acreage in Yucatan. There are ten companies in the United States making fiber from the Yucatan-grown plant, one concern alone using annually 40 carloads of fiber. There is no practical method whereby the twine can be recovered once it is used in tying the bundles of grain, a fresh supply being demanded each harvesting season. It is a low-priced crop and cannot be grown on high-priced land, the yield of sisal not exceeding $100 an acre. American hemp as a substitute is too valuable and is not otherwise altogether satisfactory.

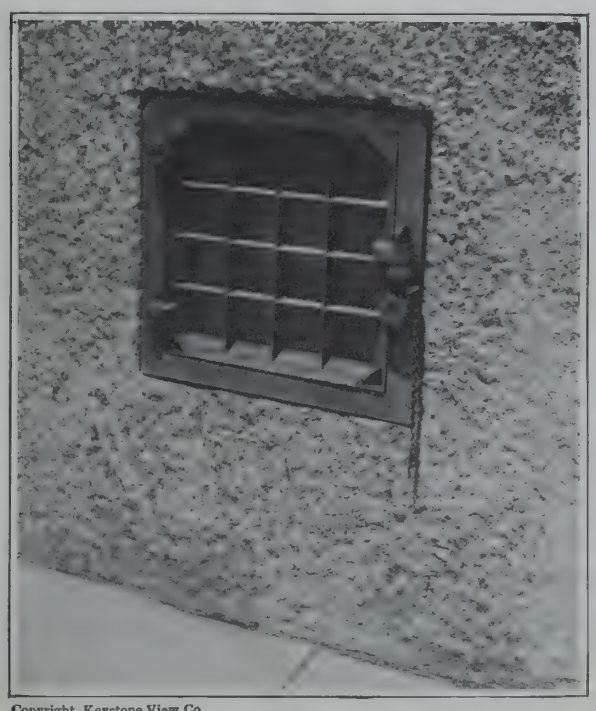
About 2½ pounds of twine is used for each acre of grain, with the exception of corn, which requirement is in excess of these figures.—By *S. R. Winters.*

***Left:*** **Thrifty henequen plants cultivated in Cuba.** ***Right:*** **Bales of henequen fiber on their way from warehouses to pier in Yucatan, Mexico**

## Putting the Street Lamps into Niches

THE huge Kensico Dam at Valhalla, N. Y., which forms part of the Catskill water supply system of New York City, is crowned by a broad roadway which is used by pedestrians and vehicular traffic alike in crossing the broad valley at that point. Hence one of the problems confronting the designer of the dam was the installation of some suitable lighting system for the roadway. At first the usual lamp post idea was suggested, of course using suitable lamp posts in keeping with the general appearance of the masonry construction. But on second thought it was decided that lamp posts of any sort would detract from the appearance of the dam, with its impressive flat top unmarred by any projections.

The final system of illumination adopted and installed on the Kensico Dam roadway consists of a large number of niches in the parapet walls, each containing a high power nitrogen-filled incandescent lamp behind a sheet of prismatic glass. A near view of one of these lighting units is shown in the accompanying illustration, which depicts how the prismatic glass and lamp are protected by a grillwork. The unit may be opened for inspection, cleaning, and the renewal of the bulb by opening the padlock. These units, placed at intervals of about fifteen feet, first on one side and then on the other side of the roadway, spread out their rays so that they virtually overlap, thus forming one sheet of light from one end to the other of the dam roadway. The effect is most pleasing, since the light is kept near the surface where it is needed, unlike the usual system of lighting.



Copyright, Keystone View Co.

**Lighting unit installed a foot above the sidewalk along parapet roadway of Kensico Dam**

# Taking on Oil a Mile at Sea

## How Vessels Receive Fuel at Mexican Gulf Ports Without Approaching the Docks

By James Anderson

AMERICAN efficiency has made oil one of the first requisites in the commercial life of our times. American initiative has uncovered many secret deposits of the fluid. American energy has brought it to the seaboard. Now as a fitting culmination American skill has devised a novel and most up-to-date system of loading it on ships a mile or more out at sea.

To those accustomed to think that the only way a vessel can be expeditiously loaded is to run her into some port, tie her up to a dock and then put a crew of stevedores to work placing the cargo snugly on board, the idea of loading a vessel well out to sea seems an impossibility. But that is just what is being done daily in Port Lobos and at several other points along the Mexican coast by a number of different American oil companies.

**Beach end of the pipe line, completed and ready to start operations**

Port Lobos, it will be recalled, came into the immediate limelight wherever oil was sold in the latter part of 1919. During the month of November of that year this port, the centre of that bleak stretch of windblown tropic shore that stretches from the mouth of the Panuco River at Tampico across some forty miles of coastal plain to the Gulf of Mexico, rolled up a monthly total of 2,000,000 barrels of oil. But not satisfied with this fact, Port Lobos is now seeking new laurels because it is there that the most satisfactory system of loading tankers that has ever been devised is being carried on.

The big ships stand a mile out in the open roadstead, pick up the buoyed end of a water-proofed pipe line, and through it suck in the oil until their bunkers are filled.

Along this stretch, occupied formerly by only pelicans and airgrettes, but now by wireless stations and those who produce the black liquid wealth from nature's storage tanks, powerful pumping stations dot the landscape. They bring oil from the wells far inland to store it in great tank farms from where they pump it through submarine feeding lines to tankers flying the flags of all nations. The work of loading these vessels through these submarine feeding pipes constitutes one of the most interesting experiments of the generation. While the process is practically new it has already proved a godsend to vessels which previously found it necessary to load with oil under the greatest difficulties, in ports that did not offer the proper facilities for docking and where there was the usual Mexican delay in awaiting pilots, custom officials, immigration inspectors, or doctors. Furthermore in following the new process of loading one has no harbor dues to pay, nor is there any danger of damaging small floating craft or wharfage construction.

*TO those who are accustomed to think that the only way to load a vessel is to tie her up to a dock in some port and put a crew of stevedores to work, such a thing as loading ships while at sea would seem to be impossible, yet it is now being done daily and has proved the most satisfactory system of loading tankers yet devised. It is carried on by a number of different American oil companies in Port Lobos and at other points on the coast of the Gulf of Mexico. Just how it is accomplished and how successful it has already been proved to be is told in this story.*—THE EDITOR.

As a first preliminary to the process of loading a vessel at sea with oil, two lines are laid on the ground for more than a mile back from shore connecting the pumping station with what are known as the sea lines. The sea-going pipes are painted with crude petroleum and then wrapped tightly in burlap. They then receive another heavy coating of crude oil, are once more wrapped in burlap, and again painted. All this is to assist the pipe in resisting the corrosion by salt water when it is under the sea. As an additional protection river clamps of wood about four feet in length are placed about every connection to prevent attack by the water at the joining. When ready the entire pipe is lifted to trucks on a narrow gage track in a straight line back from the shore. On the end that is to project into the sea a connection of 120 feet of 8-inch flexible rubber hose, heavily reinforced, carrying a securely closed nipple, is attached.

A sand sled, used to prevent the pipe from burying itself while being pulled to sea, is next placed under the front end of the line. A gasoline drum is tied on the top of the sled to keep the end of the line visible while being drawn out. Guiding blocks are then placed at either side of the line at its ocean end. Next a favorable day is awaited, when one of the tankers especially prepared for the purpose is moved into position to pull the line seaward.

Following these preparations the line is fastened to the tanker by means of a heavy cable. Then when all is in readiness the ship, light from lack of cargo, comes in as close as possible to the shore and then steers a straight course away from the beach to fixed mooring berths. The line moves seaward at the rate of about four miles an hour. As the trucks on which it is conveyed come to the end of the track they roll off on to tank plates and are removed from under the sea line.

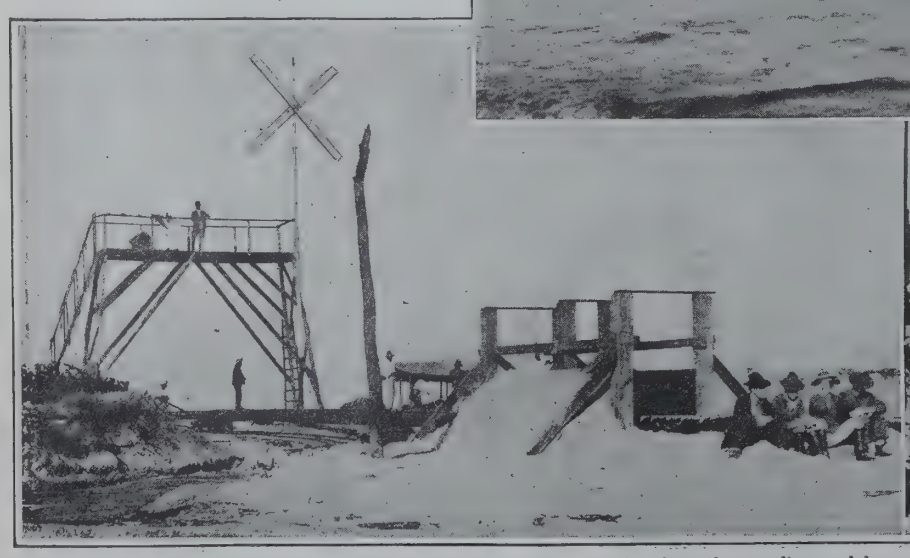
Once the pipe lines begin to move seaward little time is lost in going ahead. In fact, from that point until the completion of the whole operation only about twenty minutes elapse. The operation must keep moving and once it gets started cannot be stopped, as the line would break of its own weight were an attempt made to pull it further after it had settled to the floor of the Gulf. Naturally it takes a great deal of skill and careful handling to pull one of these lines to sea successfully. Much of the credit for the success with which the operation is carried out should go to the managers.

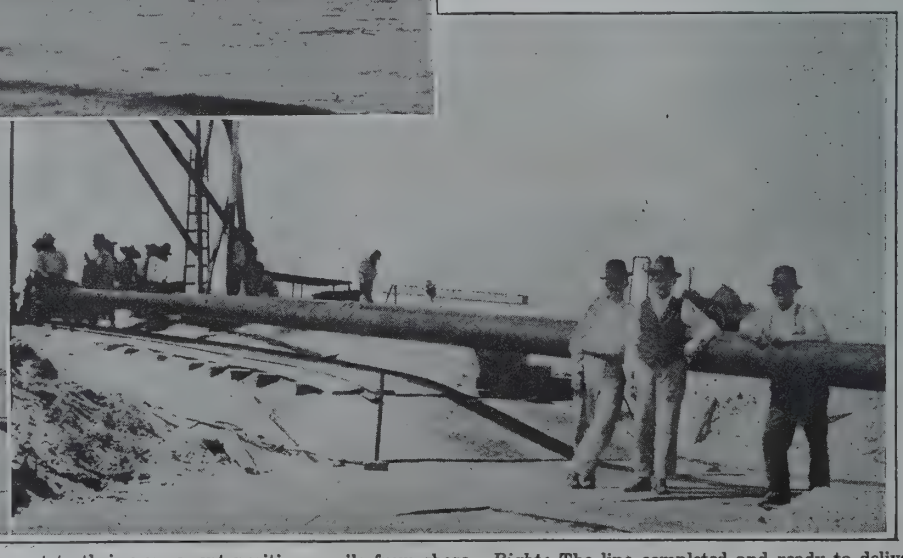
The line laid to sea, connections are placed from it to the storage tanks, and the hose connection on the ocean end of the line is "marked" by means of a wooden float which is capable of carrying the weight of the hose.

Wherever the loading at sea takes place there you will see in readiness at all times numerous motor surf-boats. Each one is directed by what is called the mooring master. When a ship is announced, or is sighted, this surf boat is sent out to meet it. The mooring master boards the ship and takes full charge.

When the ship has been moored and

(Continued on page 392)





*Left:* The bridge from which the beach signal is operated. *Above:* Hauling the sea line and buoy out to their permanent position a mile from shore. *Right:* The line completed and ready to deliver oil to vessels far out beyond the surf

**Some details of the pipe line with which ships are supplied with oil while standing a mile off shore**

Two views of the wireless outfit installed on the Regatta Committee barge during the recent Gold Cup Regatta on the Detroit River

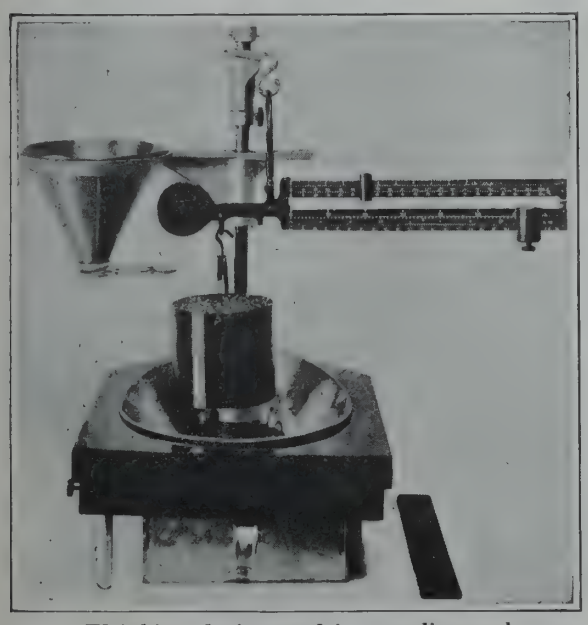
## Using Wireless to Catch the Newspaper Edition

IN order to catch a certain edition, necessitating the rapid transmission of the results of the races, a Detroit newspaper made good use of wireless telegraphy during the Gold Cup Regatta, held recently on the Detroit River.

A short-range wireless transmitter and a conventional receiving set were installed aboard the Regatta Committee barge, as shown in the two accompanying views. A young radio amateur of Detroit handled the press dispatches aboard the barge and transmitted them some eight miles to the newspaper office in Detroit. Thus the results of the races were immediately conveyed to the editorial rooms, whereas, upward of an hour would have been required by means of a fast boat and the information could not be issued in the desired edition.

## Simplifying the Fire-Fighters' Job

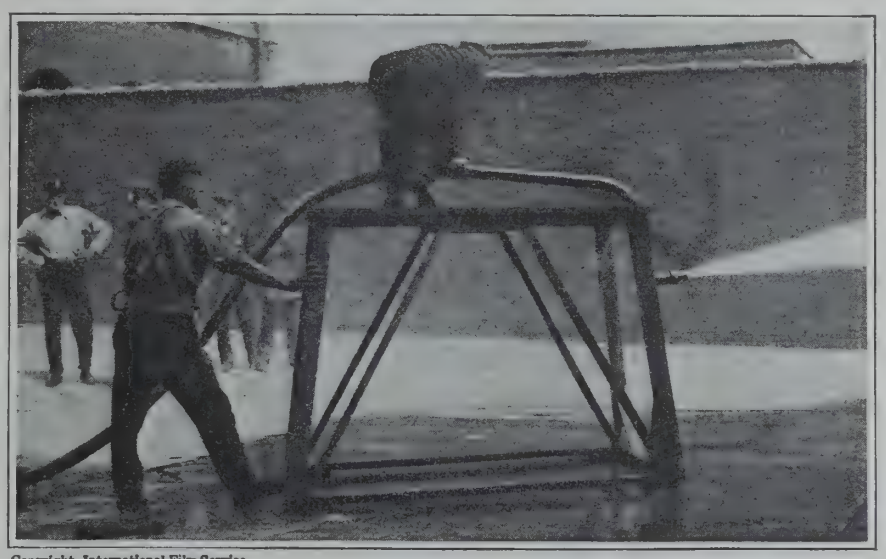
THE Chicago Fire Department has recently introduced a new form of nozzle for fighting flames from roofs and other elevated points, from which the streams of water are thrown more or less horizontally. The new nozzle, instead of being straight as is the usual equipment, has two bends as shown in the accompanying illustration. These bends are made so that the nozzle may be rested on the parapet or coping of a roof, balcony railing, fire escape, window ledge, or any other suitable object, thus taking the weight and strain off the fireman's hands. The nozzle then becomes a hinged nozzle, so to speak, which can be aimed in any direction and held in the desired position with little or no effort. By means of this nozzle several men are freed from nozzle duty and can devote their efforts in other directions.



Weighing device used in sampling and grading grain

## Speeding Up the Grading of Grain

TO expedite the efficient and accurate grading of wheat and allied small grains on the central markets, an ingenious device is used in measuring and weighing the different materials. Under normal conditions, it is difficult to fill a measure with exactly the same amount of grain from each sample and on this account a special appliance has been provided which delivers the grain by gravity into the measure that is standardized and used in keeping tab on the bulk and volume of the various samples.



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This new nozzle, which may be rested on ledges and railings, enables one fireman to handle a powerful stream of water

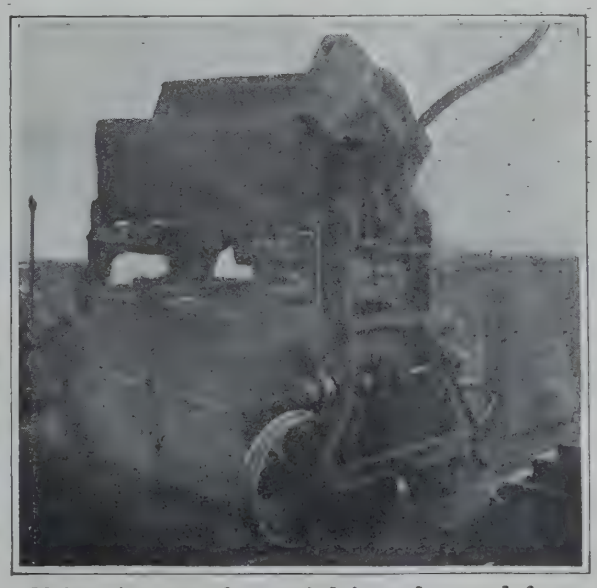
A conical reservoir with a slide mouth is used for the initial reception of the grain sample to be weighed. When full this deposit is rotated until it is directly over a one quart measure which is attached to a compensating scale which is regulated so that it weighs only the grain. The slide at the bottom of the reservoir is then opened and the grain flows evenly and uniformly under the force of gravity into the measure. When it is full, the surface is struck properly and the amount of grain then remaining in the measure is weighed accurately on the scale which is designed to weigh in terms of pounds per bushel. It is thus easily possible to ascertain the exact amount of grain in each sample and whether it is under standard in weight due to the presence of shriveled and undersize grain; and accidental errors due to irregularity in packing the quart measure are brought down to a negligible minimum.

## Conveying Molten Iron to the Molds

A NEW device for handling molten iron in a gray iron foundry has been invented by a Cleveland foundryman. It is in use in his own foundry and is a labor saving machine as well as a very efficient one. The device, as illustrated, consists essentially of a cylindrical ladle mounted on trunnions in such a way that the iron may be discharged through nozzles which become submerged when the ladle is rotated. The metal flows from the nozzles into two semi-circular guide troughs which convey it to the runners leading to the mold. The entire apparatus is carried on a frame mounted on wheels which render it readily portable.

The ends of the pouring basin are constructed of cast iron with a segment removed. The sides are made of heavy boiler plate perforated and securely riveted to the end castings. The inside of the basin is lined with one course of 1-inch fire brick. The basin is supported by trunnions which rest in sliding shoulders. The shoulders move in vertical guideways and are raised or lowered by an adjusting screw which is operated by a hand wheel. By this arrangement, the level of the pouring basin may be maintained and any depression in the track will have no effect on the iron level if the trunnion shoulders are adjusted. The rotary motion of the basin is controlled by a lever securely bolted to the trunnion flange on the operator's side of the machine. An extension arm carrying a counterweight is provided; this offsets danger of the basin's turning over of its own accord while the iron is being poured into it from the crane ladle. Two cast-iron guide troughs rest upon the side frames and may be lifted off when it becomes necessary to reline them with clay. A one-inch opening through which the iron flows to the sprues is provided in the bottom of each trough. The distance from the floor to the bottom of the basin is 3 feet 2 inches.

The entire device is supported by three flanged wheels—two on the operator's side and one on the helper's side—which run on rails spaced 4½ feet apart and permit the machine to be moved in a straight course over the molds. When several rows of molds are to be poured the machine may either be moved from one row to another by a traveling crane, or run to the end of the track and wheeled to the adjacent row of molds, for which purpose a lifting device is provided. It is said that two machines will take care of the output of a cupola which melts between 18 and 20 tons per hour and that only four men are required. Bull ladles required 14 men.



Molten iron can be carried in and poured from this straddle truck

# The Heavens in October, 1920

## The Latest Nova, and the Present State of Knowledge and Speculation About These Strange Stars

By Professor Henry Norris Russell, Ph.D.

THE principal astronomical event of the past month —announced just too late to find mention in the preceding of these articles—was the appearance of a bright Nova or temporary star in the constellation Cygnus. This object was discovered by Durning, a prominent English observer of meteors and planetary detail—on August 21st, the day after last month's "Heavens" had to leave the author's hands—as a conspicuous naked eye star, north of Delta Cygni. During the next day it increased somewhat in brightness, reaching the magnitude 1.9, which has been surpassed by only two Novae in the past century, Nova Persei of 1901 and Nova Aquilae of 1918. It then began to fade rapidly, and by September 1st was no longer conspicuous, though easily visible when one knew where to look for it. At the date of writing it is barely visible on a clear dark night without telescopic aid.

The Harvard photographic plates show that the star was exceedingly faint, if not invisible, a week before its discovery. The rise to maximum was slower than is usual with Novae, and the initial stages of the fall rather more rapid than ordinarily. Apart from this, the outburst appears to be typical. The spectrum, while the star was increasing in brightness, showed, as in other cases, dark lines only, and was generally similar to that of Altair (A5 in the Harvard classification). As the light passed to maximum the characteristic wide bright bands, with dark lines on the side toward the violet, made their appearance. Like other Novae, too, the star is in the Milky Way and not far from its central line.

How much additional information this star will give us regarding the nature of the processes which produced the tremendous outburst it is too early to say, but meanwhile, other information bearing on the problem has come in from different directions. A curious variable star T Pyxidis was discovered seven years ago by Miss Leavitt, on Harvard photographs. Usually it is very faint, of about the 14th magnitude; but in May, 1890, it rose in a few weeks almost to the 7th, and again in May, 1902, it repeated the change, falling off once more in brightness very much after the fashion of a "new star." No photographs of its spectrum were obtained during either of these maxima, which it is interesting to note took place eleven and twenty-three years before the discovery of the variability. But in 1920 the star blazed up a third time, and the spectrum was photographed and found to be of the characteristic Nova type. It is in 9h. 0m. R. A. and 32° south declination, close to the Milky Way; and on the basis of the observations of 1920 alone, the star would undoubtedly have been classified as a Nova. The fact that it has been known to brighten up twice before appears to be no reason why we should change our opinion. Most Novae, it is true, have exhibited but one great maximum. But several, including the bright Nova Aurigae of 1892, and two fainter ones recently observed in Ophiuchus, have fallen off in light, sometimes greatly, and then come up again, though before the earlier outbreak was fully spent.

### A Monumental Variable

But if we grant T Pyxidis to be a Nova, what shall we say about the still more remarkable star Eta Carinae? This famous southern variable (in a nebulous region in the heart of the galaxy) was of the fourth magnitude when first noticed by Halley in 1677. It appears to have been a fairly conspicuous naked-eye object till about 1810, when it rose in brightness. For almost twenty-five years, from 1826 to 1850, it was above the first magnitude, and in 1843 it exceeded Canopus in brilliancy, and was surpassed only by Sirius. After 1850 it faded steadily, and since 1865 it has been fainter than the seventh magnitude, with small fluctuations. It is now of magnitude 8.3, and not more than 1/4000 as bright as at its maximum. Its spectrum during the past thirty years has consisted mainly of bright lines, with a continuous background crossed by dark lines, which, according to Miss Cannon, disappeared about 1895, coincidently with a diminution of the star's brightness by about one-half. This spectrum is strongly reminiscent of that of Novae in certain of their later stages. What the star's light would have revealed in the years of its great brightness we, alas, will never know; for in those days the spectroscope was unknown.

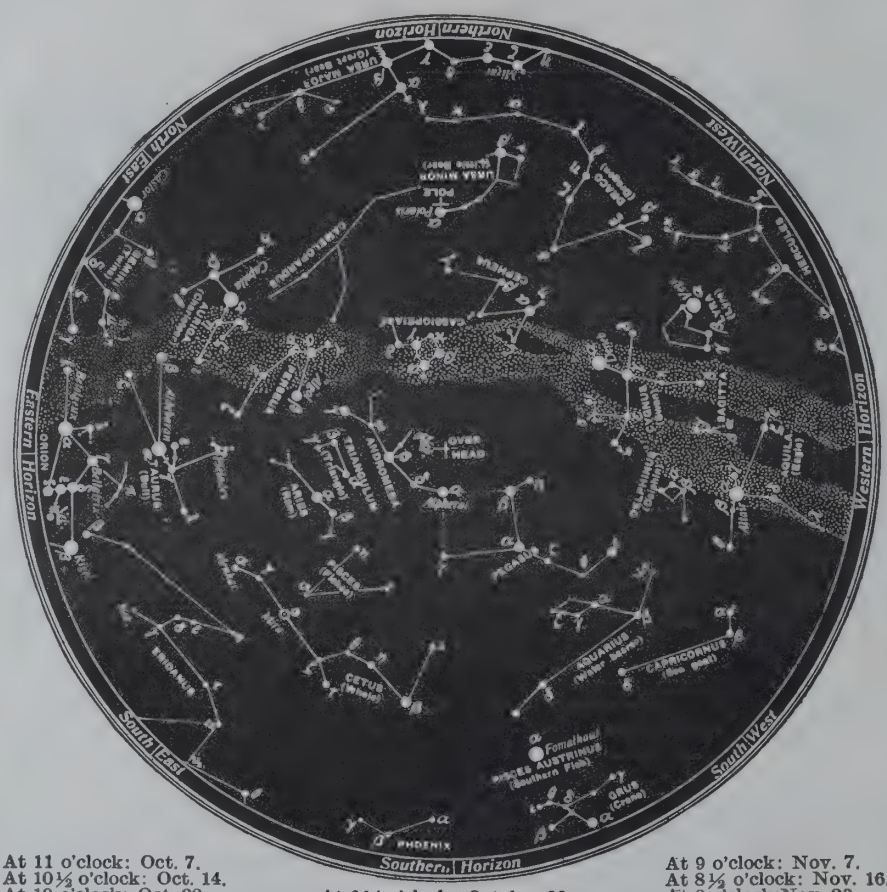
There appears therefore to be a series of objects strikingly similar in spectrum, and all characterized by great and non-periodic fluctuations in brightness. At one end stand the typical Novae, which rise to maximum in a day or two, and fade away in a few years, losing by far the greater part of their light within the first few weeks. At the other end of the scale is Eta Carinae, whose changes have occupied not days, but years.

### What Does It All Mean?

It would seem probable, though by no means certain that similar causes are at work in all these variables. What happens during the outbursts, however, is still obscure. We recorded a few months ago the evidence that makes it probable that, in the typical Novae at least, a shell of incandescent gas is actually thrown out from the star at enormous speed; but we can only guess, rather wildly, what the forces behind such explosions can be like.

Certain things, however, are evident. Whatever the catastrophe may be, it does not destroy the star, nor even use up any great portion of it—for T Pyxidis has gone through the process three times in the last thirty years, and is still there. Moreover it must be a standard process, in the sense that it occurs with fair frequency somewhere in the stellar universe, probably as often as once a year. This disposes once for all of the idea that the Novae are produced by collisions between two stars; for it can easily be shown that, even among the billions of stars that probably exist, no two should collide except at average intervals of many millions of years. The hypothesis of a collision between a star and a nebula, or possibly a small body of planetary dimensions, meets this difficulty; but it is hard to see how such a collision could be the direct cause of the expulsion of a shell of gas at such enormous speed.

Perhaps a solution may be found in the idea—supported now by evidence from many quarters—that the stars contain some vast store of energy, of little known nature, which they are gradually transforming into heat and radiating away. Under ordinary circumstances, it is probable that the rate of generation of heat is automatically regulated to balance the loss by radiation. But it is quite conceivable that some sudden disturbance in the substance of the star, near the surface, might cause an abrupt liberation of a great amount of energy, sufficient to heat the surface excessively, and drive the hot material off into infinite space, in much the form of such a shell of gas as seems to have been observed in the case of Nova Aquilae. A collision with a swarm of meteors might easily provide the necessary initial shock—this acting as the detonator, rather than as the bursting charge. If a star has run into one such cloud, there may be others near by, and the repeated outbreakings of Nova Aurigae, and even of T Pyxidis, may thus be simply explained. Such a long-continued outpouring of energy as took place from Eta Carinae is harder to understand. But with the rapid advance of our knowledge of the properties of the stars on the one hand, and of the very nuclei of atoms on the other, we may, perhaps before very many years have passed, find ourselves nearer a solution of the problem.




At 11 o'clock: Oct. 7.
At 10½ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.
At 9½ o'clock: October 30.
At 9 o'clock: Nov. 7.
At 8½ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on October 7, etc.

NIGHT SKY: OCTOBER AND NOVEMBER

### The Heavens

The finest parts of the evening sky are now in the east and west, along the line of the Milky Way, which extends over our heads in a vast arch. Beginning at the west, we find Aquila low down, and Lyra a little higher and to the right. Above the latter is Cygnus—no longer marked by the brilliant new star, which has faded from view to the unaided eye. Then come Cepheus and Cassiopeia, almost overhead, followed by Perseus, high in the east, with Auriga below, and Taurus to the right of the latter. Gemini and Orion are rising, below Auriga and Taurus, but are not yet fully seen.

The northern and southern skies are dull in comparison. The Great Bear is far down on the horizon, and Draco and Ursa Minor are below the pole and to the left of it. Opposite these, across the Milky Way, are Pegasus and Andromeda, close to the zenith. South of this, and extending far to the east and west, is one of the poorest regions of the heavens, which surrounds the southern pole of the Milky Way. The only stars within it which are really conspicuous in our latitudes are Fomalhaut, in the Southern Fish, and Beta Ceti, farther to the eastward. Aquarius, Capricornus and Eridanus, which occupy the remainder of the southern sky, do not boast among them all a single star as bright as the second magnitude.

This is true, at least, for observers in our latitude. Farther south, in tropical countries, the rather conspicuous southern constellations of the Crane and the Phoenix become prominent, and the first magnitude star Achernan (Alpha Eridani) comes into sight.

### The Planets

Mercury is an evening star all the month, and is best seen about the time of his elongation, or greatest apparent distance from the sun, on the 25th. He is then 24 degrees from the sun, but so far south that he sets a little before 6 P. M. (standard time) and is rather hard to see. Venus is an evening star, and is gradually drawing away from the sun; but she, too, is far south, so that even at the end of the month she remains in sight only until 6:25 P. M.

Mars likewise is an evening star, but farther east, and he therefore remains in sight longer—until about 8:30 in the middle of the month. Jupiter is a morning star, rising at 3:25 A. M. on the 1st and at 1:55 on the 31st. Saturn is about ten degrees farther east,

(*Continued on page 392*)

**The start of displacement boats. Won by "Rainbow" with an average speed of 39.48 miles per hour**

## The Fastest Boat in the World

THAT amazing little craft, "Miss America," after winnning the Harmsworth Cup in British waters was brought back to America and entered as a contestant in the Gold Cup Regatta, which was held on the Detroit River. She not only won the one-mile championship trials for the Lake George trophy, but secured several other trophies. The contesting boats had to make six one-mile dashes over the mile course. In one trial, which had to be thrown out because only three of the six watches got her time, "Miss America" was clocked at the rate of 78.94 miles an hour. The average time for the six dashes credited the little boat with an official speed of 76.73 miles an hour. Her best official run was made at a speed of 77.85 miles an hour. The performance was very consistent, as will be seen from the following timings: First mile, 47.06 seconds; second mile, 46.2 seconds; third mile, 47.1 seconds; fourth mile, 46.6 seconds; fifth mile, 47.3 seconds; sixth mile, 46.6 seconds.

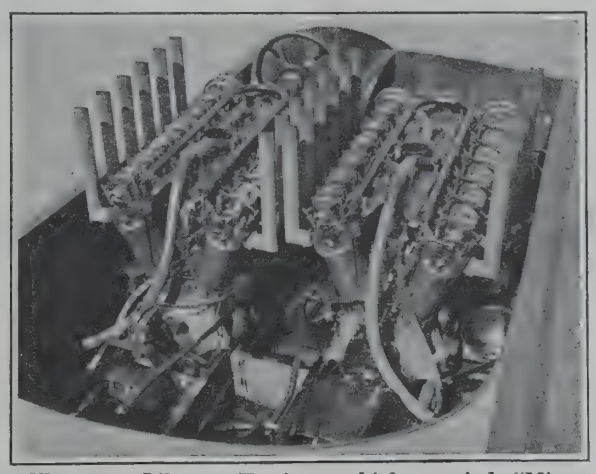
Only one other hydroplane competed in these trials, the "Miss New Orleans," which made an average speed of 58.35 miles per hour, with a fastest lap of an even sixty miles. We show an illustration of the start of displacement boats with stock marine motors for the Fisher trophy. It was won by the "Rainbow," of the Royal Hamilton Yacht Club, with an average speed of 39.48 miles an hour, and a maximum speed of 40.75 miles. The "Miss America" is a diminutive craft with an enormous horsepower for her weight. She has a single step, and is driven by two Liberty motors with a combined horsepower of 800.

## Artificial Glaciers for Irrigating Dry Land

AN ingenious method for securing a supply of water for their parched fields during the hot season is practised by the mountaineers living upon the slopes of the Karakorum, the great chain of mountains at the northwest extremity of the Himalayas, and is thus described by Mr. Dainelli, a member of the Italian Alpine Club, in the Bulletin of that organization:

The inhabitants choose points as high as possible in lateral valleys which furnish but little water supply in the summer to the principal valley which it is desired to irrigate. Such spots are chosen as are shut in with steep banks so as to receive little or no sun. During the hot season these valleys are filled with successive layers of straw saturated with water and if possible with dry pine needles and even charcoal. Before the first snow fall the bed thus prepared is covered with pebbles. When the heavy snowfalls of the season are at an end the top layer of snow is covered with straw and then with earth.

**"Miss America," running her fastest mile at an official speed of 77.85 miles per hour**



**The two Liberty Engines which carried "Miss America" to victory**

## Daring Voyage of a Wrecked Ship

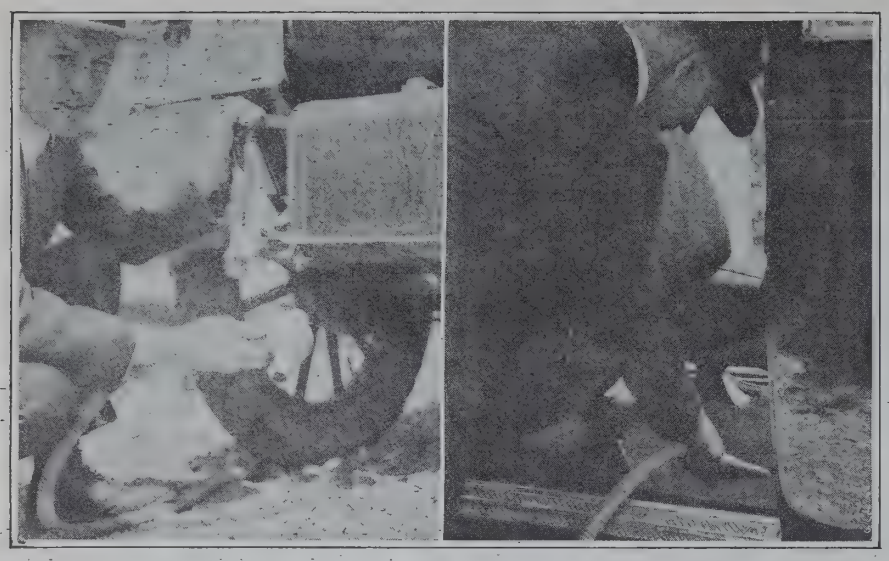
THE United States ship "Ophir" is one of the Dutch merchantmen which were commandeered by the United States. She was employed in carrying supplies to and from the seat of war, and, as fate would have it, on her last trip, she carried some ammunition which caused no end of trouble; for while she was at Gibraltar the ammunition caught fire and sent the ship to the bottom. She lay there for four months, and was subsequently raised by our Navy Department and brought back to the United States.

What the fire did to the ship will be understood from the accompanying photographs. The woodwork, it will be noted, was entirely burned away, leaving only the open steel framework of the boat and superstructure deck. Moreover, the ammunition in the hold exploded under the fierce heat, and the shell fragments passed through the steel deck above, giving it the proverbial pepper-box appearance. The ship was in bad shape, for her hold was open to the sea. Nevertheless, it was believed that good seamanship was capable of bringing her from Gibraltar to Norfolk, where it was decided to carry out repairs. As it turned out the "Ophir" during her trip ran into one of the worst storms that the Navy men who brought her over had ever encountered; nevertheless, although she rode with her decks open and with the seas washing through into the hold, she was kept afloat by running the pumps continually throughout the voyage; and though it is estimated that the gale blew at times with a velocity of one hundred miles an hour, the "Ophir" did not send out any S. O. S. call. The courage and skill required under these extremely trying circumstances will be understood, when it is remembered that the photographs herewith shown were taken after the ship arrived at Norfolk.

## Selenium

WHILE several fields of usefulness have been found for the element selenium, it may still be produced in far greater quantity than present demands would justify. Consequently its utilization offers an interesting field for research. Professor Victor Lenher has been giving particular attention to the chemistry of selenium oxychloride and has found it to be a solvent with remarkable properties.

***Left:*** **U. S. S. "Ophir," burned and sunk at Gibraltar, was brought to Norfolk, Va., in the condition shown, weathering some heavy storms.** ***Right:*** **The between-decks, showing how exploding shell fragments tore through the steel deck, until it looked like the proverbial sieve**



A member which fastens on to the exhaust of the engine, creates the vacuum for the nozzle used in cleaning the automobile

## A Vacuum Cleaner for the Motor Car

THE last word in automobile accessories is the vacuum cleaner which is operated by the exhaust of the engine. This device, which is shown in the accompanying illustrations, consists of a member which is placed on the exhaust of the engine and which creates the vacuum, a long flexible tube, and a suitable nozzle. By running the engine at slow speed a sufficient vacuum is obtained to clean the automobile in a far more thorough manner than can be done with the conventional methods.

## Getting Away from the Conventional Rudder

AGAIN we have with us the two-part rudder, which permits a power boat to be reversed without altering the speed or direction of the engine. Similar devices have been described in these columns as far back as two years ago, when a similar scheme was introduced by H. O. Wetendarp of Boston, Mass., with excellent results in the case of a small motor boat.

This time it is a British inventor who comes forth with a two-piece rudder. His device consists of two curved deflectors, each deflector of about the same area as the usual rudder. The rudder post consists of a steel rod attached to one deflector, and a steel tube fitting over the steel rod, which is attached to the other deflector. Two steering wheels are provided, one operating the left blade and the other the right blade. This device is more than a rudder; it is a brake as well. For instance, when the two deflectors are closed and placed directly behind the propeller, the engine may be going at full speed or less, and yet the boat slows down, and then begins to move backward. By gradually opening the deflectors the reversing action becomes weaker and weaker as the propeller has a tendency to propel the boat forward. Swinging both deflectors to one side or the other causes the boat to respond in the same manner as if a rudder were employed. Full speed ahead is attained when the deflectors are open and parallel to each other.

New form of rudder installed on a small motor boat

## Expediting the Stamping of Letters on Soft Metals

FOR stamping letters, figures or any characters on metals or other substances while in a soft state, an ingenious marking machine has been placed on the market by a Chicago manufacturer. This machine consists of a frame with a fixed base, said frame carrying a heavy shaft on which two large disks are pivoted. These disks house between their inner walls a number of small disks of tool steel. The disks rotate on their own axes while the characters on their peripheries are used for obtaining the impressions desired.

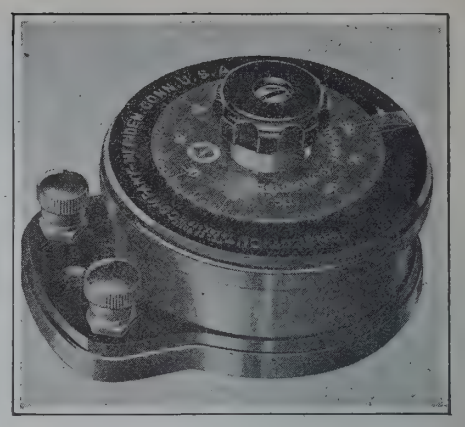
The device has an automatic feed and each size of character has a fixed feed. Cams and a multiple rack shaft action cause the feed, and the impression is obtained by means of a crank shaft connected with a handle and connecting rod. This mechanism is so constructed that the characters will not break if any part of the metal should develop resistance. The adjustment for obtaining impressions on various sizes of objects or work being done, is controlled by turning the ball handle in either direction and following the gage on the side of the device until the desired impression is reached.

The machine illustrated is for use with hand power, but it may be operated by machine power. A full alphabet and the numerals from 1 to 0 in 1-16, 1-8, 3-16, and 1-4 inch sizes are furnished with the device.

## Something New in Electrical Variable Condensers

IN an effort to produce a simpler and more compact construction, an electrical instrument manufacturer has recently introduced the variable condenser shown in the accompanying illustration. Also it is claimed for this new condenser that its results are more constant and that finer adjustments are possible.

Compared with the usual variable condensers used in fine laboratory work and more so in radio communication, with their assemblies of finely separated plates which work in and out of each other without touching, the new condenser is remarkably simple. It consists merely of a fixed plate at the top and a movable plate at the bottom. The bottom plate can be actuated up or down by means of a fine screw thread attached to a suitable handle, thus decreasing or increasing the distance between plates. A spring placed upon the screw operates to open the plates when the nut is unscrewed on the shaft. A mica washer separates the two plates, so that they cannot come into contact with each other. The variation of capacity is obtained by merely screwing the nut upward and downward on the screw shaft, and the thread is selected so that the entire range of capacity is secured by one turn of the nut.



General appearance of the new variable condenser introduced for laboratory and radio work

## Scientific Investigation of Artificial Wool

WIDESPREAD interest having been taken in a new artificial wool, an exhaustive investigation into the properties and merits of the fiber has been made by Prof. Eber Midgley, head of the department of textile industries of the Bradford Technical College, whose main conclusions may be summarized as follows:

Professor Midgley has demonstrated by machinery tests that the artificial wool is unsuitable for use in the spinning of yarn on the worsted principle, though he admits that there may be some scope for the employment of the fiber in the woolen industry. It is impossible, however, he adds, to produce from artificial wool a fabric comparable with one composed of pure wool.

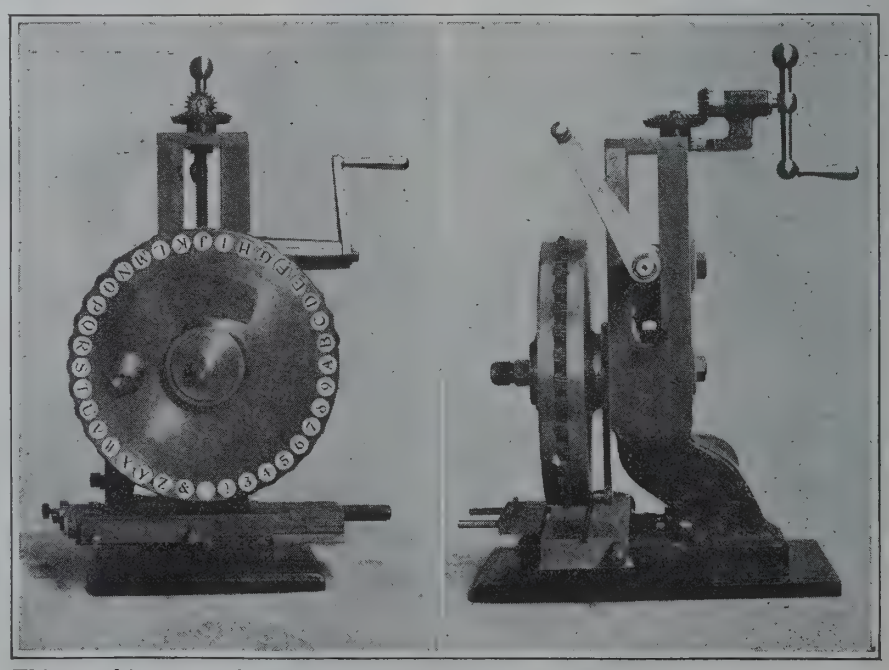
When compared with a low quality of worsted wool, artificial wool indicated a decided lack of uniformity in diameter, strength, and elasticity, factors which are essential in the manufacture of worsted yarns.

In order to provide the artificial wool with most favorable treatment, the Continental systems of combing and drawing were employed. The result of the combing was 39 per cent top and 61 per cent noil, as compared with 82 per cent top and 18 per cent noil in the case of pure wool; while the result of the drawing, blending it with pure wool, was an uneven yarn.

By suitable manipulation a yarn can be spun on the woolen principle entirely from artificial wool, but the type of yarn will be thick and limited to use as weft. Developments can be anticipated on the lines of mixing the material with wool and remanufactured wool for the purely woolen trade; but so long as the present supplies of cotton and wool are maintained, artificial wool and many other substitutes cannot, in Professor Midgley's opinion, in any way affect either the cotton or the wool industries.

## Recent Patent Decisions

**Wireless Telegraphy.** — This is a suit involving the Fleming patent so far as concerned a detector for radio waves. Eight or nine years after the date of this patent, several experts in the radio art, while using these devices as radio wave detectors, observed that the detectors possessed the function of oscillating, or, in other words, of generating radio waves. This was an extraordinary additional property or function of the so-called incandescent lamp detector, of which Fleming had no knowledge. A claim of the patent provides for the combination of a vacuous vessel, two conductors adjacent to but not touching each other in the vessel, means for heating one of the conductors, and a circuit outside the vessel connecting the two conductors. While the claim covers broadly the device when used in the radio art, yet when read with the context of the specification, it is plain that Fleming's disclosure was addressed to the use of the instrumentality as a detector only. It is a principle of the patent law that a patentee is entitled to all the benefits of his invention, whether or not known to or foreseen by him. Therefore the patent is held infringed by a generating device. Judgment for plaintiff.—*Marconi. Wireless Tel. Co. v. DeForrest Radio & Tel. Co. U. S. D. C. of N. Y.*



This machine puts the stamping of lettering on soft metal in the same class as the cutting of packing room stencils

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

## Pertaining to Apparel

BRASSIERE HOOK.—G. T. COLTER, 419 W. 119th St., New York, N. Y. The invention relates particularly to a hook used with corset covers or brassieres. An object is the provision of an arrangement which may be used for properly holding a brassiere in position in connection with a front or back laced corset. Another object is to provide a hook or fastening means which is adapted to be hooked into or interlocked with the front of a corset without producing an undesirable lump or gathering of material, and also without danger of becoming dislodged when in use.

HOSE SUPPORTER.—A. D. PERALTA, c/o Young & Glen, 68 Broad St., New York, N. Y. The invention relates to garment supporters and is more particularly adapted to hose or socks. The general object is to provide a support which can be conveniently applied and detached, the support preventing suspender ends in looped form through which a portion of the hose may be passed, together with a slide into which a portion of the hose may be drawn and then securely clamped.

SNAP FASTENER.—W. H. LAMMERS, 2495 8th Ave., New York, N. Y. The object of the invention is to provide a snap fastener for garments as distinguished from hooks and eyes, buttons, and the like. Among the objects is to provide a fastener of minimum thickness when applied to the garment. More specifically the fastener comprises head and socket members adapted to be attached directly in the usual manner, but are not easily separable directly, the separator being effected by a sliding movement.

## Pertaining to Aviation

AIRPLANE.—H. C. NEAL, Philadelphia, Mississippi. An object of the invention is to provide an airplane embodying features of construction, whereby the airplane acts as a parachute in the event that the engine stops so that the aviator may land with safety. A

A PERSPECTIVE VIEW OF AN AIRPLANE AS INVENTED

further object is to provide mechanism capable of adjustment and operation while the machine is in motion, to enable the airplane to remain in substantially one position, to facilitate observations, and to remain in a normal position when standing on the ground.

WING.—H. M. WOLFE, 75 Vesey St., New York, N. Y. The invention relates to aeroplanes and other aerial machines; its object is to provide a wing more especially designed for use on a fighting air craft, and not liable to collapse when subjected to heavy strains or when riddled with bullets. Another object is to render the wing exceedingly durable and capable to readily withstand heavy wind pressure.

## Electrical Devices

ELECTRICAL TOY GUN.—T. H. HALLINAN, 212 Madison Ave., Paterson, N. J. An interesting toy is provided by this invention, which permits of rapidly firing a number of shots from the same gun, using electro-magnetism for the propulsive power. The operation of this small, rapid-fire gun is controlled electrically and it may be manipulated by a very small child without danger to the operator or to any surrounding objects.

FLASH LIGHT.—J. VINCE, 429 78th St., Brooklyn, N. Y. The invention relates to portable electric lights of the class including a battery and lamp, the one movable relatively to the other, a shell inclosing the battery and supporting the lamp having means to connect the same in circuit at the front of the battery, together with means tending to separate the lamp and battery to break the circuit at the front of the battery.

ADJUSTABLE ELECTRIC CONTACT.—F. H. LORKING, 10 Davenport Terrace, Wayville, South Australia, Australia. This invention comprises a contact for electrical work which grips an adjusting nut and even when the wire holding nuts are slackened off for adjustment or other purposes remains locked to the insulating lock and is capable of a micrometer adjustment. It is especially suitable for circuit breakers, polechangers and circuit controllers used in signal engineering or other work where comparatively light currents are used.

ELECTRICAL FIXTURE.—F. L. BUTLER, 740 E. 36th St., Chicago, Ill. An object of the invention is to provide an electric fixture in which the stem is effectively insulated from the parts supporting the stem in position so that an electric current is prevented from passing from the current carrying system to the parts of the fixture, without the use of an auxiliary insulating joint such as would otherwise be required.

TELEGRAPH INSTRUMENT.—J. V. GUERRE, Santiago De Cuba, Cuba. An object of the invention is to provide an improved mounting for the parts of the instrument so that the magneto can be adjusted to vary the gap between the magnet cores and the armature operated thereby. A further object is to provide means for controlling and adjusting the elastic support of the armature carrying lever.

APPARATUS FOR PROPAGATING AND INTENSIFYING ELECTRICAL OSCILLATIONS.—J. J. CALLAGHAN, P. O. Box 574, So. San Francisco, Cal. The invention relates to wireless apparatus and has for its object the provision of a construction for propagating and intensifying electrical oscillations so as to approach the frequency of light waves. Another object is to arrange short period oscillating coils in line, with their respective planes parallel in conjunction with a mirror whereby the propagated wave will be unidirectional.

## Of Interest to Farmers

AGRICULTURAL IMPLEMENT.—J. VERSTEEG, 802 Pittsburg St., St. Johns, Oregon. The invention has for its object to provide in an implement of the character specified, a means for thoroughly cutting and breaking up the soil as it is turned up by the plow, the said means working upon the strip of earth turned by the plow and being operated by the movement of the plow.

## Of General Interest

LAMINATED GLASS.—M. W. GLEASON, address R. B. Cressman, c/o Gleason-Tubout Glass Co., 200 5th Ave., New York, N. Y. This invention has particular reference to the construction of vitreous objects such as globes for electric lamps or the like in which the shell is composed of a plurality of laminæ, the innermost of which is of a distinctive color, the outermost of which is clear, while the intermediate layer is of a translucent nature with a neutral tint. Among the objects is to produce a light very similar to natural daylight with an increased strength of globe.

SAFE.—A. H. GERNSBACHER, 1405 Canal St., New Orleans, La. The invention has for its object to provide mechanism of the character specified, for the safe storage of jewels, money, and the like wherein a safe is incorporated in the hollow metal post or posts of a bed, in such position as will always be convenient for the user, the chamber formed being provided with partitions arranged transversely, and having a door provided with a lock.

AUTOGRAPHIC ATTACHMENT FOR CAMERAS.—M. B. BOYCE, 2 5th Ave., Haverhill, Mass. This invention relates more particularly to autographic cameras, the object being to provide a simple and inexpensive means in the form of a series of letter and numeral blocks movable in guided relation, whereby to produce even, legible exposure titles and similar data upon negatives capable of ready manipulation and uniform exposure.

LADDER.—F. M. DE SAUSSURE, JR., 801 E. North St., Greenville, S. C. This invention relates more particularly to folding ladders especially those in which the side rails are swingable by virtue of pivoted rungs toward and away from one another; among the objects is to provide means automatically acting in connection with a supporting surface whereby to lock the said rails of the ladder section in non-shiftable relation when engaged with a supporting surface either in a horizontal line or upon more or less of an incline.

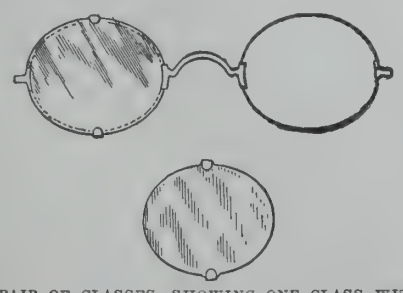
PROTECTED PNEUMATIC HEEL.—W. E. KAY, 422 E. Broad St., Elyria, Ohio. The objects of the invention are to provide a pneumatic heel in which air is confined under pressure, and in which the amount of resiliency is variable under variable pressure according to the weight of the individual wearing it. One of the important features is that the weight will be evenly distributed over the entire wearing surface of the heel, another feature is the use of replaceable tread members so that the wearing position is always renewable without disturbing the body of the heel.

MOP AND BRUSH HOLDER.—L. WECHSLER, 514 W. 126th St., New York, N. Y. This invention relates to scrubbing and brushing apparatus and has particular reference to a device designed to hold either a mop head or a scrubbing brush. Among the objects is to so construct a mop stick and attachment means at the end thereof as to accommodate the device for holding and manipulating any one of several different types of cleansing devices.

SAFETY RAZOR.—A. H. BRYANT, Glen Ridge, N. J. Among the objects of the invention is to provide a holder for a thin blade which will expose the entire length of the cutting edge of the blade and which will hold the cutting edge firmly along a predetermined line in respect to the holder. A still further object is the provision of a holder for a safety razor blade which is formed comparatively thin and compact and with all the resilient members formed as integral parts of the head.

WHISTLE.—J. C. WARD, 817 E. 17th St., Little Rock, Ark. The invention relates more particularly to a whistle to be placed between the lips of the user and in which the body of the whistle is formed with a transverse orifice, the sound being produced by blowing air across the orifice. The invention is also provided with a movable member under the control of the user and arranged to be vibrated to produce trills or intermittent whistling sounds as well as the clear strong whistling sound.

SPECTACLE SHADE.—K. R. GITTERMAN, c/o A. C. Harragin, 30 Le Compt Place, New Rochelle, N. Y. An object of the invention is to provide a tinted or clouded eyeglass shade preferably made of celluloid which may be mounted on the frame or lens of the eye glass or spectacles in order to form a pair of shaded spectacles or eyeglasses. It is an object to provide shade pieces which are small and convenient to handle, and which may be



A PAIR OF GLASSES, SHOWING ONE GLASS WITH SHADE HOOKED ON

carried in the spectacle case with the glasses and be placed in position over the lenses and held there by hooks and removed at will. The same inventor has also been granted a patent for spectacle frames, which may be used in connection with the shades so that a simple shade may be slipped in position into the rim holding the lens.

MARKING DEVICE.—G. J. ANDERSON and W. R. SMITH, 4808 Superior Ave., N. E., Cleveland, Ohio. This device is adapted particularly for branding articles such as rubber tires, inner tubes and the like. It is designed for efficient use with articles having curved, rounded or other abnormal forms or contours. The dies or stamps are adjustably held in the device and can be manipulated while the device is in use so as to contact efficiently with the surface to be marked.

ILLUMINATING ATTACHMENT FOR TELESCOPES.—E. L. BECK, Manor, Pa. The object of the present invention is to increase the utility of telescopes by providing an illuminating device to render the cross hairs more visible. This is of particular advantage in surveying instruments. The illuminant consists of a light cell attached to the eye piece, which contains a small electric lamp and reflector that casts the light upon the cross hairs.

LIQUID DISPENSING DEVICE.—W. F. LERCH, 30 Fannington Ave., Hartford, Conn. The purpose of this invention is to furnish a convenient form of container for iodin or similar liquids, such as antiseptics or astringents, to treat cuts, wounds, sores and the like. It is particularly adapted for the treatment of the throat and gums, for surgical and dental operations and for the treatment of insect bites.

ACCOMMODATION LADDER FOR MARINE VESSELS.—E. J. SIMS, c/o Bauer, 223 Schermerhorn St., Brooklyn, N. Y. This ladder is arranged to be conveniently moved into position for use over the side of a vessel or to be returned to inactive position on a deck when not in use. Means are provided to prevent the stairway or ladder from being broken or otherwise damaged while being moved into active position or back into inactive position.

SLIP COVER FOR CANS.—H. L. STRONGSON, address Loeb-Strongson Corporation, 25 East 112th St., New York, N. Y. The invention relates to tableware, milk tins, or sealed cans of all varieties, and provides a cover to conceal the unsightly appearance of the milk tin when it is placed on the dining table. The slip cover is of pleasing appearance and is provided with a pouring spout.

CONSTRUCTION OF OPHTHALMIC MOUNTINGS.—O. G. SCHUTZE, 73 Victoria Street, Forestville, near Adelaide, State of South Australia, Australia. By means of this invention, lenses of rimless spectacles or pince-nez may be secured to their straps to be adjusted as either "central," "inset" or "offset," and either in "level" or in "lowered" position. The invention also simplifies the assembling of individual members of the mounting in the case of pince-nez.

METHOD AND APPARATUS FOR CONSTRUCTING CONCRETE PILES.—S. M. COTTEN, c/o Office Engineer, City Engineering Department, Phoenix, Ariz. The invention reates to the construction of "cast-in-place" concrete piles. It provides a new method of driving and casing the hole in the ground (into which the concrete pile is cast) so as to develop a minimum of resistance to penetration. This object is accomplished by using telescoping cylindrical sections so designed, related and actuated that skin-friction between the casing and the ground penetrated is practically eliminated.

MERCURY-VAPOR LAMP.—M. J. CORNU, 26 Rue de Babylone, Paris, France. This lamp consists of a thick-walled quartz tube containing two electrodes between which an arc of small length but of high specific brilliancy is formed. The thickness of the tube is equal to at least half the internal diameter, so that the heat of the arc is retained and the mercury vapor is maintained at a high temperature.

AWNING.—W. H. MCOMBER, 803 Chicago Ave., East Chicago, Ill. The present invention covers an improved awning particularly designed for internal use at windows or other openings for supplying a continuous current of cool air to the sleeper in a bed adjacent to the window. The construction is such that the air is constrained to flow in at the lower part of the casement over the face of the sleeper and out above the upper casing.

CAN WASHER.—G. C. WILTSIE, 320 Avenue B, Schenectady, N. Y. One of the principal objects of this invention is to provide means whereby the cream ordinarily left in a milk can after the same has been emptied may be saved. It is quite common in a creamery or ice-cream plant for as much as a pint or a quart to adhere to the can. By means of a rinsing and sterilizing apparatus this cream may be washed out of the receptacles and recovered.

GUN CONTROL.—S. MCG. THOMPSON, Box 745, Fernandina, Fla. Special means are provided in this invention for controlling a gun mounted on the deck of a vessel so as to keep it normally in a horizontal position, or in any other predetermined position regardless of the roll of the vessel. A U-shaped mercury tube mounted upon the gun is arranged to control certain motor operated devices for elevating and depressing the gun so as to keep it always trained on the target.

WELL BUCKET.—C. D. BEHAN, Stigler, Okla. Mr. Behan provides in the present in-

vention a bucket especially designed for use in wells of small diameter, for instance, cased wells. The bucket is provided with a valved bottom so that it can fill from the bottom without having to be tilted. In the same way it may be emptied from the bottom when at the top of the well.

BALL BEARING COUNTER.—R. B. Austin, Deceased (Cyrus B. Austin, Administrator), Delaware, Ohio. In order to provide a rapid means of taking any predetermined number of balls from a container and thus dispensing with the necessity for the separate counting of them the inventor provides a plate formed with a predetermined number of perforations in which the predetermined number of balls will be held while the remainder will roll off when the pate is tipped.

ICE-CREAM DISPENSING DEVICE.—W. L. Hix, 1306 Gartland Ave., Nashville, Tenn. The object of this invention is to provide a device by means of which quantities of ice cream of various flavors may be held in a single container and may be dispensed from the bottom of the container in blocks of predetermined size. Means are also provided for gradually moving the cream downward in the container as it is removed at the bottom.

CLOSET VENTILATOR.—E. A. Johnston, Park Ave., Johnstown, Pa. A motor-driven exhaust fan is employed for exhausting the air from the bowl and a float and seat operated switch are provided for controlling the action of the motor and fan. A switch having a spring pressed plunger holds the seat in a normally slightly elevated position and means are provided for throwing the switch and stopping the motor upon flushing the bowl.

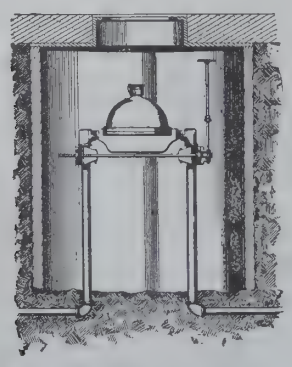
COMBINED ADVANCE DISCOUNT VOUCHER CHECK, ORDER, AND COMMERCIAL LETTER.—J. H. Camp, Ravenswood, W. Va. The invention relates to a written instrument or combined voucher check, blank order and personal letter from the seller to the purchaser, and a blank letter for reply to the seller from the purchaser. The invention aims to eliminate the necessity on the part of the traveling salesman in disposing of merchandise.

TUBE CAP.—A. Landgrebe, 1724 Barnes Ave., Van Nest, Bronx, N. Y. Among the objects of the invention is to provide means whereby the conveying tubes for dispensing beverages may be kept in a most sanitary condition, but providing for the most expeditious cleansing of the same when necessary. The caps as well as the tubes may be made of any suitable material such as glass, porcelain or the like.

## Hardware and Tools

CLIPPER.—J. W. Price, Box 651, Henryetta, Okla. The invention has for its object to provide a simple inexpensive mechanism of the character specified suitable for any form of clipping, wherein the parts are easily operated, may be easily disassembled for any purpose, and are practically noiseless in operation.

METER SUPPORT.—C. C. Bradfield, Harbor Springs, Mich. The invention relates more particularly to meter supporting connections within meter boxes, the object being the provision of mechanism by which a meter may be readily and quickly removed and replaced



A VERTICAL TRANSVERSE SECTION THROUGH THE METER BOX, SHOWING INVENTION

from the cover of the box in such a way as to insure rigid support of the meter in its operative position, and effective non-leaking connection between the meter nipples and the elbows.

PORTABLE CLAMP.—A. Anthony, 1037 N. Castle St., Baltimore, Md. This invention relates to clamps used in wood working, a purpose is the provision of a simple clamp of the type comprising a stationary jaw and a movable jaw, and cam actuating means for securing the movable jaw in any adjusted position; in this device screws are eliminated and in their stead cam levers substituted, permitting of quick adjustment.

DETACHABLE SPRING HINGE.—P. Klein and H. Humphrey, 181 Glessner Ave., Mansfield, Ohio. An object of the invention is to provide a detachable spring hinge composed of two levers, and consisting of only two parts, the part fixed to the door or window frame and the part associated with the spring so that no spare parts will become lost when the hinge is not in use. Another object is to provide a spring which will allow of quick and easy removal of the door or window from its frame.

SHADE FIXTURE.—W. McC. Neale, Box 351, Greensboro, N. C. This invention has for its object to provide a simple, efficient, inexpensive device for permitting a shade to be raised or lowered when desired without the necessity of springs and without the necessity of handling the shade itself. A steady continuous pull on a cord will raise the shade and a slight continuous release of the cord will lower the shade. A quick and total release of the cord locks the shade in adjusted position.

TUBE COMPRESSOR.—J. J. Bowes, Jr., 1508 E. Jackson St., Pensacola, Fla. The object of the invention is to provide a device adapted for compressing a flexible tube to prevent the flow of liquid therethrough, as for instance the tube of a syringe, wherein the arrangement is such that the tube will be efficiently clamped shut assuring a water-tight closure without undue wear on the tube.

## Heating and Lighting

WATER HEATER.—De Forest L. Rathbone, Box 1020, Jacksonville, Fla. The object of the invention is to provide an automatic water heater which employs live steam as the heating means for the water, the steam valve being thermostatically controlled by an arrangement of certain of the heater parts with the ultimate result that the temperature of the usable water is kept at a substantially uniform degree.

HEATER.—H. Fickersen, 718 Park Ave., Hoboken, N. J. The invention relates to a heater with a construction of lining which prevents the radiation of heat through the sides of the heater, and directs the heat through the top. A further object is to provide a lining which may be inserted in an ordinary oil heater and which may be adapted for other forms of heater without changing the construction.

ROLL HEATING DEVICE.—A. S. Rice, 108 W. 22nd St., New York, N. Y. The invention relates more particularly to roll warming devices for use in hotels, restaurants and the like. The prime object is to provide a device in which the heat supplied is furnished by a heater of the electric type. A further object is to construct the device in such manner that the heated interior is automatically provided with necessary amount of moisture, to prevent the drying out of the rolls.

## Machines and Mechanical Devices

MACHINE FOR PEELING TOMATOES.—C. Kirino, P. O. Box 418, Ogden, Utah. The invention relates to a machine for peeling tomatoes or other vegetables or fruit having a skin of a nature to be loosened by scalding; it more especially relates to a machine through which the fruit is run and whereby the skin is divided into sections while on the fruit and subsequent operations performed of scalding the tomato and removing the skin sections. A distinguishing feature is the provision of means for impaling the tomatoes without bruising or crushing them.

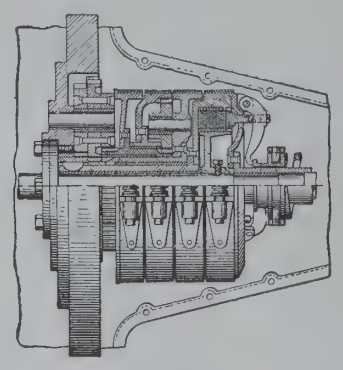
BARREL WASHING MACHINE.—H. Reininger, c/o Consumers Brewing Co., Cleo and Liberty St., New Orleans, La. The object of this invention is to provide a construction whereby the interior and exterior surface of a barrel, package or the like may be substantially simultaneously cleaned. A further object is to provide a single structure in which a number of different steps are provided for the cleaning so that the barrel may be fed in at one end and discharged at the other without manipulation or guidance by an operator, the soaking, washing and scrubbing being carried on automatically.

PERFORATING MACHINE FOR BANK DRAFTS AND OTHER DOCUMENTS.—G. A. Crocco, Rome, Italy. The invention refers to perforating machines in which numbers and words are first prepared singly by rotating the lettered or numbered disks of a setting device which is then brought in such position as to cause groups of pins or punches to pass through and to pierce the paper, leaving in same a number of holes to show the figures or letters impressed.

DETACHABLE FASTENER FOR CYLINDRICAL SCREENS.—W. L. Leach, 110 E. Broadway, Brownwood, Texas. More particularly the invention relates to means to detachably connect and fasten the ends of a strip of reticulate material in order to form a grading cylinder, which may be interchanged and renewed without difficulty, rendering the cylinder adaptable to various uses by inserting screen mesh of different gages.

GLOVE TURNING MACHINE.—D. Baum, Livermore Falls Glove Co., Livermore Falls, Me. Gloves, particularly the cheaper grade of cotton, canvas and similar woven material, are made wrong side out and must be turned before forwarding to the trade. The invention has for its object to provide means for quickly turning the gloves, the device operating entirely automatically.

PLANETARY GEARING.—S. V. Dickman, Shavertown, N. Y. An object of this invention is to provide means whereby three forward speeds and a reverse can be transmitted from the drive shaft to the driven shaft by the selective operation of brake bands controlling



A VIEW PARTLY IN ELEVATION, PARTLY IN SECTION

drums. A further object is to provide mechanism of the character stated which is compact in assemblage, comparatively simple in construction and strong and durable in use.

WAVE MOTOR.—J. W. Southwick, 752 Excelsior Ave., Akron, Ohio. The invention has for its object to provide mechanism for converting the energy of the waves into useful work. The device comprises a reservoir, a funnel-shaped passage leading from the shore to the front wall of the reservoir and adapted to receive the breaking waves, a pipe leading from the small end of the passage delivery to the reservoir, and turbines in the bottom of the reservoir for utilizing the water power.

MACHINE FOR MAKING PAPER BOXES.—A. W. Harris, Sleepy Eye, Minn. This invention relates more particularly to a machine for the making of box bodies open at the top and bottom, and such as are used by florists, market gardeners and other persons for growing young plants therein to be subsequently transplanted in lieu of the flower pots heretofore used for this purpose, such boxes being known in the trade as dirt bands.

DOOR OPERATING MECHANISM. — J. Baloc, 742 Altic St., Hazleton, Pa. The object of the invention is to provide an automatic door opening mechanism particularly designed for opening and closing garage doors and the like, and arranged to open the doors by an advancing automobile, to keep the doors open until the vehicle has safely passed and finally to close the doors and hold the same in closed position.

EMBROIDERING MACHINE.—J. G. F. Rooker, Vryenban, near Delft, Netherlands. The invention relates to a machine for automatically sewing characters, figures, etc., in woven materials and the like. The machine is arranged in such a manner that a predetermined character, word or number can be sewed once in a piece of material or more than once subsequently in different pieces of material, the machine needing to be adjusted but once.

VALVE.—S. J. Connell, 115 9th St., Brooklyn, N. Y. The invention relates more particularly to a valve for steam traps, the purpose being to permit the exhaust of water of condensation when the latter reaches a predetermined level, an object being to provide a valve which can be quickly assembled, which will maintain a higher closure, and which will comprise but two main parts coupled together without employing nuts, bolts or other removable devices.

ATTACHMENT FOR EARTH-WORKING MACHINES.—L. H. Towner, 3rd and Lake Sts., Muskogee, Okla. Among the objects of the machine is to provide an attachment for a road grader or road drag, to prevent the side draft or side skidding of the rotatable disk, an to provide for its operating within the earth for a suitable distance, and to provide means to vertically adjust the anti-skidding disk, so that it may be elevated above the earth during the transportation of the machine.

SAFETY GUARD FOR PUNCH PRESSES.—A. Koetting, 423 Wythe Ave., Brooklyn, N. Y. The object of this invention is to provide an automatic guard or fender adapted to be brought successively into position to protect the operator's hands from injury due to the descent of the power operated tool such as a punch, die, or the like. The device will not interfere with the normal intended operation of the machine.

PEGGING MACHINE.—J. Larsen, 13 Frederik den VII Gade, Copenhagen, Denmark. The invention relates to a pegging machine for use in the shoe-making industry. The machine performs the pegging in a manner strikingly resembling hand work, the peg being forced down into the hole produced by the awl by a hammer stroke which is like the strokes by which the shoe maker drives in pegs.

MACHINE FOR FORMING ROLLS ON TOY BALLOONS.—H. R. Gill, c/o Eagle Rubber Co., Ashland, Ohio. An object of the invention is to provide an arrangement of rotary brushes having flexible covers thereon of chamois, muslin, cheesecloth or other suitable material, which frictionally engage the open end portion of the toy balloons and roll the same to form a bead thereon. A further object is to provide means for guiding and feeding the balloons to the head forming device.

APPARATUS FOR PRODUCING DRIVING BELTS.—A. Carlsen, Lyngby, near Copenhagen, Denmark. The object of the invention is to use cross-woven linen tracks, i. e. linen in which all the threads run diagonally and all end in the edges, which by a special gluing machine are gued together in plies. By using diagonally woven linen the belt does not fray in the edges, its strength is increased, and it is not so liable to be destroyed by running on small pulleys.

GLOBE VALVE.—W. H. Johnson, 6217 Loomis Bldg., Chicago, Ill. The invention has for its object to provide mechanism in connection with valves, so arranged that whenever the valve is turned to open or close it will be ground at its seat to provide for intermittent regrinding of the contact surfaces of the valve and seat, and wherein the controlling mechanism is outside the valve casing.

DENTAL CROWN-MAKING MACHINE.—I. Navarro, M. Santa Capilla a Majares No. 15, Caracas, Venezuela. Among the principal objects of the invention are to facilitate the manufacture of dental crowns, to provide a power machine having substitute parts to permit employment of a machine for various operations, and to provide a machine for performing the entire operation resulting in completing the crown.

## Medical Devices

DOUCHE CAN.—F. J. O'Rourke, 8th Ave., Whitestone, N. Y. The object of the invention is to provide douche cans with diaphanous indicators whereby the user can see at a glance when the water or medicated liquid contained in the can begins to flow out to the afflicted part, and whereby the user can gage the amount of liquid discharged. Another object is to protect the indicator which is usually glass, against accident and to readily replace the same in case it becomes defective.

## Musical Devices

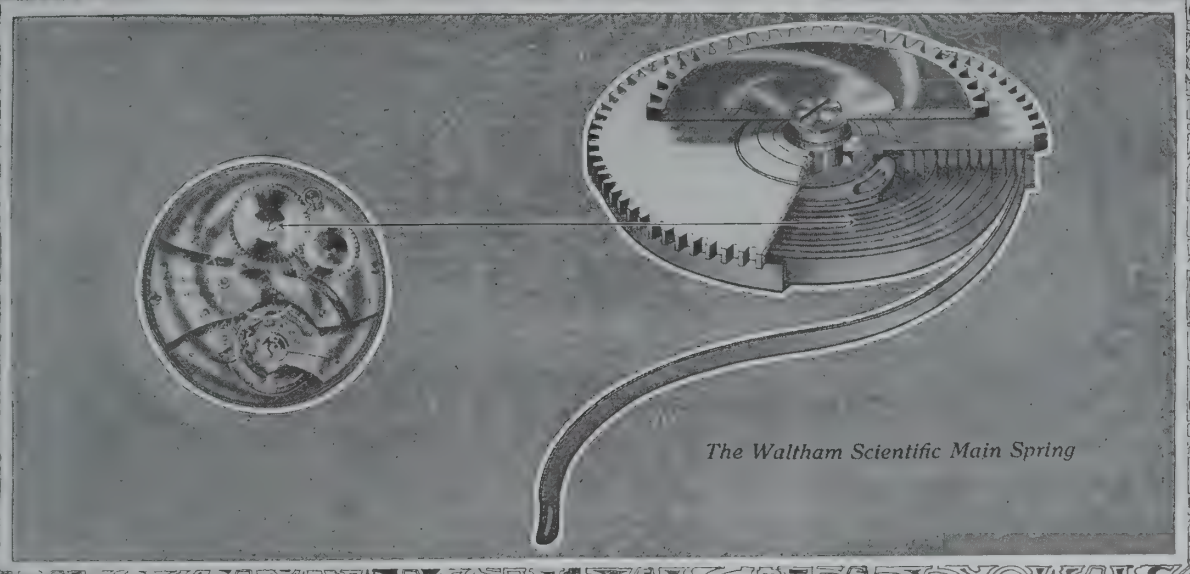
SOUND BOX FOR PHONOGRAPHS.—A. Rogati and L. Aronne, Kimberly Phono Co., 226 Fayette St., Perth Amboy, N. J. The invention relates to sound producing machines. Among the objects is to construct a sound box with front and rear walls, and provide means for connecting the periphery of one wall to that of the other. Another object is to provide means coöperating with the stylus bar for varying the volume of the tone produced by the machine.

REPRODUCER FOR TALKING MACHINE.—J. W. Kaufmann, 1730 N. Monroe St., Baltimore, Md. The object of the invention is to provide a connection between the needle and the diaphragm controlling lever which will eliminate the usual rigidity between these parts, substituting a resilient connection, of a substantially U-shaped spring connecting the needle holder with the reproducing lever.

PLAYING DEVICE FOR STRINGED MUSICAL INSTRUMENTS.—C. Haberman, 87 Ferry St., North Bergen, N. J. The object of this invention is to provide a playing de-

(*Continued on page 388*)

# PROOF




THE MOST SCIENTIFICALLY BUILT WATCH IN THE WORLD

## The Waltham Scientific Main Spring— The Power That "Drives" Your Watch

THE Main Spring is to a watch what gasoline is to an automobile — the power that drives the mechanism.

With this difference — that the Main Spring of a watch must supply power with a constant and even tension — with no acceleration or diminution in order to secure accurate time-keeping.

A Main Spring should measure in length, width and thickness correctly for the particular size of watch it is to fit — as, for example, a Main Spring for a gentleman's size high-grade watch should measure 25 inches in length and be approximately three times the thickness of a human hair.

The problem that confronted watchmakers was to produce a Main Spring without any variation of thickness for its entire length. This problem was solved by John Logan, an inventor of the Waltham Watch Company, who perfected a method and created the machines which have made Waltham the largest and most famous Main Spring producers in the world.

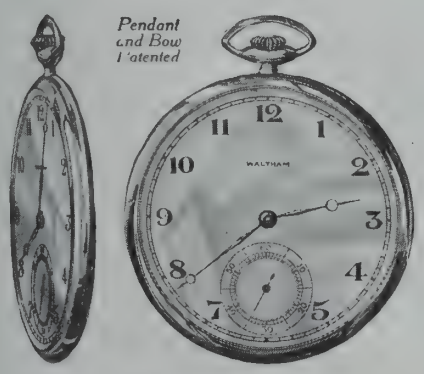
The superior time-keeping ability of Waltham Watches created a world demand for Waltham Main Springs.

You will observe in the illustration (above) that a unique feature of the Waltham Main Spring is the reverse curve, so difficult to produce, yet so essential to time-keeping dependability.

This reverse curve adds power as the spring tension diminishes, giving the Waltham Watch an equality of motive power during the twenty-four hour interval of winding.

From the brief description and proof it is easy to understand that the unscientific hand-made Main Spring will cause erratic time-keeping and dissatisfaction.

The Waltham Scientific Main Spring protects the money you pay for a watch and provides another important reason why your Watch Selection should be a Waltham.

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Extremely thin at no sacrifice of accuracy
Maximus movement 21 jewels
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$200 to $325 or more
depending upon the case

*This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request. Waltham Watch Company, Waltham, Mass.*

# WALTHAM

## THE WORLD'S WATCH OVER TIME

## RECENTLY PATENTED INVENTIONS

(*Continued from page 386*)

vice more especially designed for playing the melody strings without the use of picks. Another object is to construct the device in a simple manner, and to enable the player to sound the strings with a tremolo effect in case such is called for by the music.

### Prime Movers and Their Accessories

ROTARY ENGINE.—J. G. PORTER, 914 Macdonald Ave., Richmond, Cal. This invention relates more particularly to rotary engines which are operated by direct and expansive pressure of a motive fluid or gas introduced therein, and has for its object to produce an engine which shall be simple in construction and operation and in which the operation is wholly internal and having an adjustable expansion control.

LOCKING DEVICE FOR ECCENTRIC BUSHINGS.—F. J. MCAVOY, 496 Clinton Ave., Newark, N. J. The invention relates to internal combustion engines such as are in use on automobiles. The object is to provide a locking device for eccentric bushings arranged for convenient attachment to the engine or motor to lock the eccentric bushing in place and to allow of using the device as a spanner wrench for turning the eccentric bushing after the same has been unlocked.

Another patent granted to the same inventor provides a locking device for a bushing provided with an eccentric on which is journaled a sprocket wheel engaged by a sprocket chain to be tightened, the said sprocket wheel being connected with the shaft of the motor generator and the sprocket chain being driven from the motor shaft and driving the motor cam shaft and the ignition timer shaft.

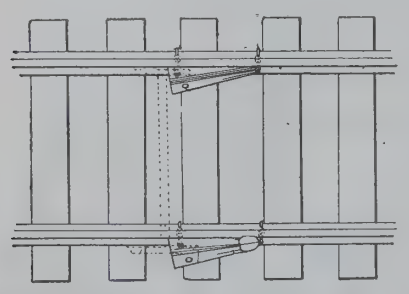
MULTIPLE INTAKE MANIFOLD.—H. P. STURM, Clarksburg, W. Va. The foremost object of the invention is to provide a manifold for an internal combustion engine, which is so designed and constructed that the proper velocity of the fuel is maintained at all engine speeds, retaining the original atomization created in the carburetor and preventing condensation on the walls of the manifold; a further object is to provide means whereby the auxiliary or high speed conduit can be cut in either automatically or manually.

INTERNAL COMBUSTION ENGINE.—G. S. MACDONALD, 114 E. 19th St., N., Portland, Ore. An object of the invention is to provide an engine which will operate economically and efficiently on crude oil, fuel oil and other liquid fuels. A further object is to provide a device having means for maintaining a supply of fuel, under constant pressure to an atomizer which discharges into a combustion chamber, the latter being filled with compressed air and the walls of the chamber being heated so as to ignite the mixture.

SPARKING PLUG FOR INTERNAL COMBUSTION ENGINES AND METHOD OF MANUFACTURING THE SAME.—C. E. GERBAUD, 102 Rue Pelleport, Paris, France. The primary object of the invention is to provide a sparking plug, the constituent parts of which are so united as to form a single integral piece which will have the effect of obviating the leakage of gas or lubricating oil. A further object is to provide a plug capable of withstanding very great temperature and heavy pressure.

### Railways and Their Accessories

CAR REPLACING DEVICE.—W. MATNEY, Box 32, Stone, Ky. It is the purpose of the invention ot provide a device for replacing cars upon the rails of a track. A further object is to provide a simple device which is reversible and may be employed for replacing

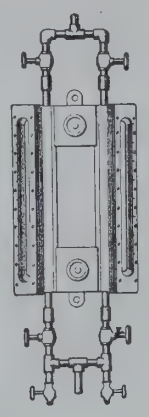


VIEW SHOWING TOP PLAN VIEW OF TRACK WITH DEVICE APPLIED

cars upon the track in either direction, having interfitting connections with the heads of the rails of a track and means which coacts with the rails for securely holding the device in operative position.

DRAW BOARD FASTENER.—A. JAEGER, 671 Front Ave., Grand Rapids, Mich. An object of the invention is to provide a fastener which is especially adapted for securing a draw board against movement and which will permit the easy removal of the fastener when desired. The invention particularly relates to such draw boards as are used in loading or unloading freight cars from docks, platforms, etc.

WATER GAGE.—D. M. MCCOOK, 409 3rd St., Manchester, Ga. A purpose of this invention is to provide a plurality of water gages arranged to give the same indications which can be observed from various angles so



SHOWING A FRONT ELEVATION AND ARRANGEMENT OF GAGES

that when applied to the boiler of a locomotive the quantity of water in the boiler can be readily determined by the engineer and fireman without moving from their respective working positions.

DOUBLE HEADING AIR BRAKE SYSTEM.—E. R. HEWITT, 15 Macomb St., Plattsburg, N. Y. This invention relates to trains headed by two or more locomotives; its object is to provide an air brake system arranged to place the engineer of the first locomotive completely in control of all available air pressure of the several locomotives. Another object is to utilize the air pressure of the main reservoir of the second locomotive to automatically assist the train pipe air pressure from the first locomotive in recharging the auxiliary reservoir of the train.

### Pertaining to Recreation

RACE GAME APPARATUS.—R. M. BRENNER, P. O. Box 151, Palisade, N. J. Among the objects of the invention is to provide a game apparatus for use in pleasure grounds, parks and other places and arranged to enable a number of players simultaneously to manipulate racing objects such as figures of horses with a view to cause such objects to travel over individual tracks thereby simulating a race, the winning being solely dependent on the skill of the player.

TOY FORT.—H. E. COATES, 2015 Stoatway, Sacramento, Cal. The invention more particularly relates to a toy fort on which a gun is mounted and from which a figure representing a gunner is adapted to emerge upon the tripping of a trigger controlling the mechanism, the arrangement being such that as the figure emerges the gun will be automatically fired to give the effect of having been fired by the gunner.

AUTOMATIC SELF-PROPELLED TOY TANK.—C. A. LEWIS and H. E. SMOCK, c/o Die Products Co., Dayton, Ohio. The invention has for its object to provide means which will automatically operate to cause a toy tank to travel or move forward in an irregular course or path. Another object is to provide means for causing one end of the tank to move up and down in a vertical plane when driven, and to cause the guns thereon to be oscillated or moved when the tank is in motion.

### Pertaining to Vehicles

SCREEN FOR WINDSHIELDS.—F. MCMAHON and R. A. HOUSTON, South Charleston, Ohio. This invention has for its object to provide a device wherein a perforated curtain is provided, having means at its ends for permitting it to be connected to the windshield supporting frame of a motor vehicle, to prevent the passage of bugs and the like when the shield is open.

LOAD CARRIER FOR AUTOMOBILES.—W. K. YOST, Box 488, San Antonio, Texas. An object of the invention is to provide means for carrying sample trunks or other loads at the rear of the tonneau of an automobile. The device is more particularly intended for use as an attachmet for a roadster with flat body extension. The carrier can be quickly applied or removed and folded into small space for storage.

ELEVATING TRUCK.—C. M. HENDERSHOTT, 39 Adsit St., Hornell, N. Y. The invention has for its object to provide a truck of the character stated which can be easily operated, and which will be of maximum strength and durability; the platform may be given any elevation desired and when elevated will securely support the load thereon.

LICENSE CARD.—C. H. CORNELL, Valentine, Neb. This invention has for its object to provide a card of the character specified especially adapted for use with motor vehicles wherein the card has a form providing for a complete description of the car and of the owner or other person to whom the card is issued and designed to be used with a plate or license tag.

GEAR SHAFT.—W. G. DRUMMOND, 112 S. 6th St., Alhambra, Cal. The invention relates to transmission devices for automobiles and motor cars, and particularly to gear shifting devices for use in connection with constant mesh gear sets, the object being the provision of an arrangement which will permit of manual selection of the gears to be engaged and automatic completion of the selected engagement when the clutch is disengaged.

TIRE HOLDER.—A. F. ENGEL, 650 Wayne Ave. An object of this invention is to provide a tire holder such as is commonly carried on motor vehicles and which permits ready insertion or removal of the tire. A further object is to provide a holder which can be swung to one side to provide a free entrance or exit for the tire, and which when moved into position and locked, will securely hold the tire against accidental movement.

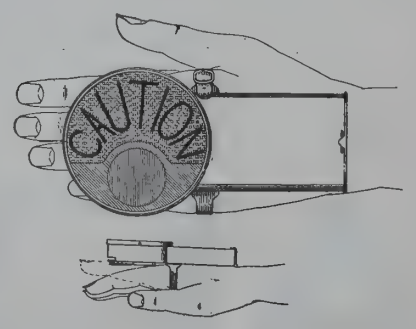
AIR PUMP.—S. S. AVERY, Pleasant Lake, Ind. The invention relates more particularly to hand pumps for inflating pneumatic tires. One of the principal objects is to provide a single cylinder pump in which the operation is double acting. A further object is to construct the pump cylinder in such a manner that up stroke of the piston is limited in its length and cushioned by a body of air which is trapped in the top of the cylnder.

RESILIENT WHEEL.—T. T. CHALONER, 510 W. 47th St., New York, N. Y. The object of this invention is to provide a construction whereby a resilient effect may be secured and at the same time any skidding or side strain taken up without injury to any of the parts. A further object is to provide a resilient wheel which is formed in sections with a set of springs and a casing therefor formed at the outer part so as to give sufficiently to allow of a proper action of the springs.

OIL FEEDER.—A. E. NICHOLLS, Wilson Creek, Wash. This invention has for its object to provide a feeder especially adapted for use with internal combustion engines of motor vehicles, the arrangement being such that all the bearings of the crank shaft will be thoroughly lubricated regardless of the degree of inclination of the oil pan.

ROAD SHOE FOR AUTOMOBILES.—L. S. ROBBINS and W. E. GILMORE, 706 Walnut Ave., Klamath Falls, Oregon. Among the objects of the invention is to provide for each of the rear or traction wheels a gripping device adapted to be introduced beneath the forward bottom side portion of the wheel to enable an automobile or similar vehicle to easily and quickly extricate itself from a mudhole or other road difficulty, the device being so constructed as to enable the wheel to secure adequate hold on the road.

AUTOMOBILIST'S CAUTION SIGNAL.—W. W. KUHLMANN, 124 29th St., Woodcliff-on-Hudson, N. J. The invention relates to a signal device which includes a battery, lamp, switch and signal element and is adapted to be worn on the sigaling hand of an automobilist

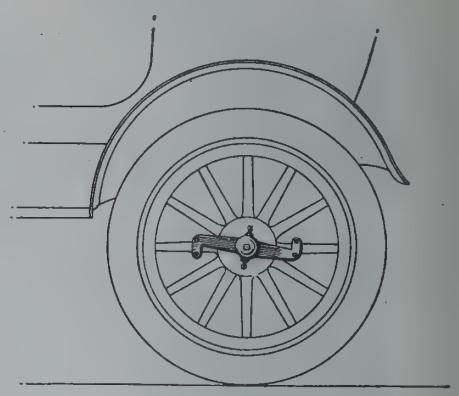



AN ELEVATION AND VIEW SHOWING HOW THE FINGER IS USED TO CLOSE THE LAMP CIRCUIT

so that in driving at night he can warn the driver of a car in the rear of the fact that he is slowing down to make a stop or turn.

REVERSING FAN.—P. JENSEN, Wayne, Alberta, Canada. This invention particularly relates to fans for circulating air about automobile engines and through automobile radiators. An object is to provide a radiator cooling fan of the reversible type which is controllable from the driver's seat so that the volume of air may be varied to suit the temperature needs of the automobile engine.

REPAIR HUB AND WHEEL PULLER.—C. N. SRADER, 116 W. Elm St., Enid, Okla. The invention has for its object to provide a device especially adapted for use in repairing broken Ford rear hubs, for permitting the car

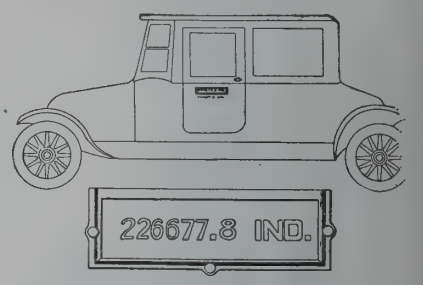


REAR WHEEL OF VEHICLE WITH REPAIR HUB IN PLACE

to be used after the hub is broken and to be safely driven a reasonable distance, as for instance, to a repair shop. The device comprises a cap being internally threaded for engagement with a hub and arms extending from the cap engageable about the spokes.

LUBRICATING PACKING.—H. A. LACERDA, c/o R. W. Benson, 50 Church St., New York, N. Y. The invention relates to automobiles having a rear axle housing through which extends the rear or driving axle. The object is to provide a lubricating packing filling the spaces between the rear axles and the rear axle housings, intermediate the inner and outer roller bearings, and capable of preventing the lubricant within the gear casing from leaking out through the outer end of the housing and onto the tires.

SYSTEM FOR NUMBERING MOTOR CARS.—J. L. CATLETT, Vincennes, Ind. An object of the invention is to provide a simple method of numbering motor vehicles, so arranged that the vehicle may be guarded against theft, and the State against loss of fees, wherein a per-




SIDE VIEW OF CAR AND PLAN VIEW OF REMOVABLE HOLDER

manent number is provided for each car, and a removable record of the said number for each car. Two sets of plates being furnished by the State, and various colors indicating various years, every year the owner surrendering one set of plate and obtaining the other.

### Designs

DESIGN FOR A TABLE.—G. POLL, c/o G. W. Poll & Co., 1918 Harman St., Brooklyn, New York.

DESIGN FOR A FINGER RING.—J. SIMMONS, c/o Goldman Kolber Co., 206 Broadway, New York City, N. Y.

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## A New Deal in the Transportation Industry

(*Continued from page 374*)

would never pay to lay rails but where there will be a large profit in using from one to two or three dozen trucks. This use, as it increases, will add greatly to the value of farms along the truck routes opened up, bring increased prosperity to the farmers and increased and cheaper food supply to the country.

To the shipper and to the general public the short haul by rail means the same excessive transportation costs that it does to the railroads. In the past years, there was no alternative. If the shipper wanted to send his product from Cleveland to Akron, he had no vehicle available other than the railroad. Although delays have been hindering more in recent years than in the past, these delays have always been a serious factor in the short-haul. Shipping time has always been out of proportion to the distance traveled on the short-haul. Furthermore, packing and crating charges which are unnecessary with trucks must be figured into the cost of the product to the consumer on all railway freight. The shorter the distance travelled, of course, the higher is the proportion of this cost.

One gain to be readily seen in any comparison between the railroad and the motor truck is the saving in favor of the truck on such items as packing and crating, cartage, tracing, switching and demurrage. While figures on all items of this nature are not always available and even when found sometimes present wide variations depending upon tonnage hauled, terminal facilities, character of freight, etc., the following costs, expressed in cents per hundred pounds, as determined by a large manufacturing company in New York, are representative:

Cartage charges from shipping platform to railroad siding, 15; cartage from freight house to consignee's receiving platform, 15; crating and packing, 24; with an additional 17 per cent increase in freight charges, due to the increased weight of shipments occasioned by crating and packing material. This totals $10.80 a ton, which must be added to freight costs.

Now that the increased freight tariffs are in force many instances where comparisons of costs in shipping by rail and by truck have heretofore been close, are showing a widening gap in favor of the truck. The largest increase in freight rates, as it happens, has been made effective in the eastern section where the highest development of truck transportation has taken place. With this increase, amounting to 40 per cent, there is every indication that shippers will analyze more closely than ever the cost of shipping by truck as compared with that of the railroad, in order that they may have an accurate picture of the relative saving which may or may not lie on the side of the truck.

Apart from the normal value of the motor truck in hauling freight at lower costs and with less loss of time, there is another factor which enters into the traffic situation of the present day; and that is the ability the truck possesses to relieve the railroads during the period of reorganization. Without a doubt, the railroad systems of the country are going into the next few years with their hands full of perplexing transportation problems, and with far too little equipment to handle their tasks as efficiently as they would like to. This will give the truck a very practical opportunity to show what it can do in relieving the railroads of some of their burdens.

The ability of the truck to assume this rôle has been proven over and over again. In almost every instance where the motor truck has been put to use, figures may easily be compiled to show how substantial this relief has been. The ability of the truck to act as a relief agent to the


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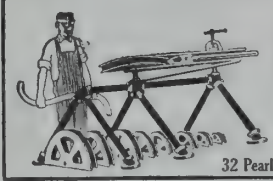

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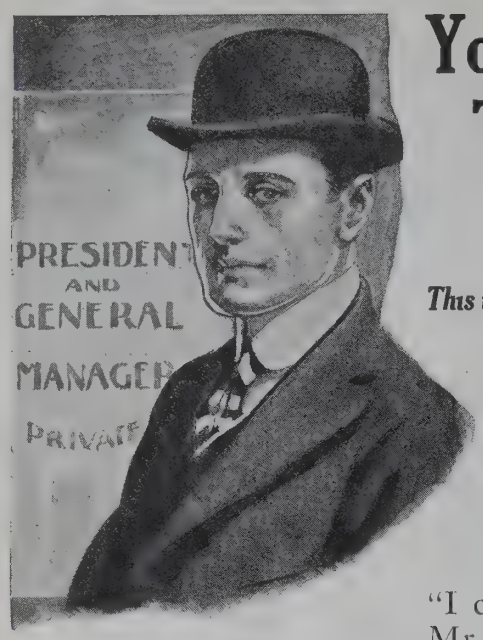


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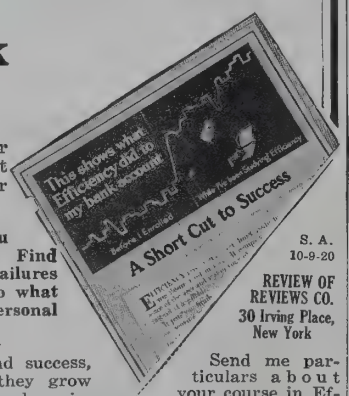


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railroads is proved quite emphatically by the Goodyear Akron-Cleveland route, wherein it is estimated by the National Automobile Chamber of Commerce, 885 freight cars are released every week for other and more profitable service.

This phase of transportation is more vital to the manufacturer, distributor and producer today than it has ever been before. At the present time this country operates approximately 2,400,000 freight cars. If, by the use of motor trucks on a 40-mile haul between Akron and Cleveland, 885 freight cars per week are released for other duties, a proportional saving over the total number of freight cars in operation the country over would mean a tremendous gain.

And the gain would not only be effected in some restricted industrial areas, but would extend to the Middle West and South where transportation is just as important in the work of bringing crops and live stock to market. Transportation is likely to be taken as a problem of local or sectional interest unless the adage of the chain and the weak link is borne in mind.

Transportation enters public life at two points: First, as a connecting link between the producer and the manufacturer; second, between the manufacturer and the consumer. A break in one connection is just as serious as a break in the other. In fact, the perplexing problems of moving the country's merchandise will be far along toward solution once the study of transportation is removed from a narrow, partisan plane and elevated to a position where it demands enlightened public interest.

The direct saving to the consuming public is perhaps the greatest justification for motor truck transportation where conditions are favorable to its adoption. Consider the food staple, milk, for example. One of the largest Detroit creameries distributes on an average of 43,510 gallons of milk every day. Of this quantity, gathered in a radius of seventy miles, 18,570 gallons are shipped into its Detroit plant by motor truck each day, as compared to a total of 16,560 gallons received by rail.

This is one instance where the motor truck, already able to compete with rail transportation on the old freight rates, will find its advantage even more pronounced now that the increase of twenty per cent in milk freight rates has gone into effect. Such savings bear directly on the pocket book of the individual, and as such will be given more and more attention and study as time goes on.

The final outcome of the present movement to let the motor truck assume a larger portion of the country's transportation tasks will mean a saving all along the line from the producer of raw material through the intermediate steps, manufacturer and wholesale distributor, to the public at the opposite end of the line. At the same time, the railroads will benefit by the saving of untold money spent now in handling traffic which as public servants they are required to handle, but which represents a heavy loss due to short, unprofitable hauls in less-than-carload lots. The farther the motor truck advances within its economic field, the greater will be the profit of the railroad, the manufacturer and the consumer.

Naturally, any development conducted on such a broad scale requires time. The railroads spent years in reaching the present point of perfection, and the motor truck will likewise spend considerable time before its maximum results can be felt. No one can say how long the period of development will be. Present-day figures, compiled by the National Automobile Chamber of Commerce, give the national registration of motor trucks as 750,000, and the annual production for 1919 as 316,364.

So far as the total potential tonnage of the motor truck is concerned, it has been conservatively estimated that the yearly average of around 500,000,000 tons will increase five or ten times when the truck is given the traffic now handled by the railroads at a loss, the traffic not handled at all, and the traffic that will appear as soon as facilities are provided.

A statement recently issued by Herbert Hoover pointed out that fifty per cent of farm produce rots on the ground for the want of transportation. There will be an immense amount of new traffic that will arise when means of moving it are provided.

The truck, therefore, appearing at a time when the transportation machinery would collapse without its help, has an almost infinite future. It has only begun to assume the burden it will ultimately bear. Its greatly increased use will be accompanied by vast benefits to its owners, to the railroads themselves, and most of all, to the general public.

## Applying Radium to Cure Man's Ills

(*Continued from page 375*

glass vial, containing the radium, in an "applicator." This is a small brass tube, very accurately made so that the walls are of uniform thickness, with a screw cap, to which is fastened a brass wire. The whole is gold plated to render it sanitary.

The applicator stops the Alpha rays and some of the Beta rays. But to eliminate the Beta rays completely the applicator is placed inside a brass tube or "screen," also made with carefully gaged walls.

This precaution is necessary because when the flesh is exposed to the Beta rays for even a short time a deep burn results, and this is not only painful but dangerous. The bombardment of the metal in the screens by the Beta rays sets up secondary vibrations which also may cause bad burns. As a precaution against these the applicator and screens are wrapped in rubber.

If the spot to be treated is on the surface the radium may be applied in the form of a flat metal plaque, to which the radium is inlaid. Another form of plaque has a corrugated surface on which the glass vials containing radium are placed and the whole is then bound in place.

If the growth to be treated comes to the surface but is deep in the flesh, the radium is placed in the hollow point of a specially made non-corrosive steel needle and this needle is inserted in the growth during the application.

The radium may even be taken internally for the treatment of rheumatism, certain kidney and liver troubles, and intestinal troubles. Of course only a very minute amount is taken, usually in a liquid. The radium is absorbed into the blood and circulates throughout the system. No actual chemical action takes place, however, even when the radium is taken internally. It simply attacks useless tissues, which are then ejected from the body by the excretory organs. There is no danger of burns from the minute quantities which are taken internally.

Outlined here are only a few of the most-used methods of applying radium. When it is reflected that it was not until 1898 that Mme. Curie first isolated radium, and not until 1910 that the use of radium for the treatment of cancer was suggested, it is seen that the art is only in its infancy. But even now whole volumes have been written on the subject and the use of radium by the surgeon has progressed far from the experimental state.

## Putting Paper on a Specification Basis

(*Continued from page 375*)

another in opposition to the extensive use of substitute materials. Cotton linters, to the extent of 700,000 bales a year, is available for paper manufacture; and where care is exercised to keep the material free of dirt and cinders a good quality paper results.

LEGAL NOTICES

# PATENTS

IF YOU HAVE AN INVENTION which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of seventy years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand-Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to **Patents, Trade Marks, Foreign Patents, etc.**

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The use of lime and limestone in the pulp and paper industry is also being carefully scrutinized by the Government scientists in order to develop specifications for lime for the different industries, standard samples and laboratory and plant methods of analysis. Similar tests are under way relating to the restricted use of chlorine for the bleaching of wood pulp. The chlorine in the various kinds of pulp has been materially reduced as a consequence of these experiments without any decidedly deleterious effects on the color of the resultant paper.

### What About Our Wheat Production?

(*Continued from page 376*)

Weld County then began to plant alfalfa as a rotative crop for the celebrated Greeley potato, as they found that the potato yield increased wonderfully when alternated with alfalfa.

Who can deny that the whole problem of refertilization of worn-out grain fields was settled by these farmers of northern Colorado? They not only demonstrated the science of green manuring but they happened to light upon the ideal plant for that important function.

Now I find in handling broadly the question of green-manuring the college professors, and the farm papers, prone to expend their efforts upon diffusive experimentation and discursive discussion. They treat green-manuring as a special process, all by itself, rather than as a part of regular farm routine. They talk about the vetches, cow peas, horse beans, soy beans, etc. If we stop to think a moment none of these is a standard farm crop and if used as an article of green manuring each must be treated specifically, whereas alfalfa is a valuable standard farm crop, and by its use may be utilized as a green manure crop without any break in farm production; that is, no time will be lost in producing a green manure crop, because it is already produced, and may be plowed under any fall and the land seeded to some other crop the next spring.

Another instance of refertilization by means of crop rotation I have recently observed in California: It is the case of sugar beet culture. The culture of sugar beets greatly improves the fertility of the land. Investigations made by the California College of Agriculture showed the following increases in the yield of various crops upon land previously cropped to sugar beets:

Wheat, yield before beet culture, 24.5 bushels; after beet culture, 41.3 bushels; per cent increase, 68.6.

Rye, yield before beet culture, 28.4 bushels; after beet culture, 40.8; increase per cent, 43.7.

Oats, yield before beet culture, 61.8 bushels; after beet culture 75.3 bushels; increase per cent, 21.8.

Barley, yield before beet culture, 23.2 bushels; after beet culture, 43.5 bushels; increase per cent, 87.5.

Potatoes, yield before beet culture, 218.6; after beet culture, 238.0 bushels; increase per cent, 8.97.

Rape, yield before beet culture, 23.2 bushels; after beet culture, 48.8; increase per cent, 110.

Here we discover a natural and easy process of producing our sugar, bread, potatoes, etc., in rotation, and at the same time maintaining the maximum fertility of our soils.

### Why We Need a Separate Trade-Mark Bureau

(*Continued from page 377*)

enabling the utilization of kerosene instead of gasoline in an engine and if so who is the rightful inventor thereof, and in doing so to consider all the fine points of chemistry and physics involved; and immediately afterward to decide whether


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NO higher tribute could be paid to Lupton Rolled Steel Skylight Bars than their selection to protect the great turbines and generators of the Buffalo General Electric Co.

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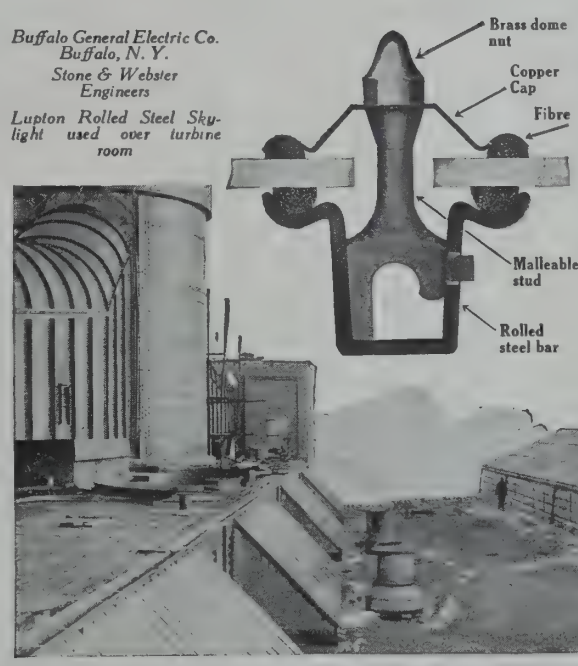
*Lupton Rolled Steel Skylight used over turbine room*

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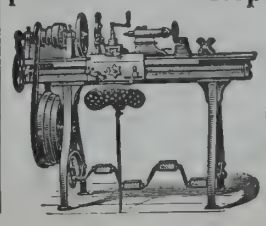

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2. The choice cuts—bacon, ham and pork loins—are only about one-third of the whole animal. They must bring prices much higher than the price of hogs to offset the low prices we get for many of the other cuts. Otherwise we couldn't stay in the pork business.

3. Only about 8 pounds out of every hundred pounds of live hog can be made into fine bacon like Swift's Premium. Only half the hogs we can buy are suitable for this brand; hence **only about 4 per cent of the total live weight of hogs we buy is sold as Premium Bacon.** Other bacon is sold at much lower prices.

4. There is an extra expense of about 8 cents per pound in preparing Premium Bacon, due to careful trimming, curing, smoking, and shrinkage. This extra expense is nearly as much as we get at wholesale for some of the cheaper cuts.

The various cuts not only bring different prices, but changing demands cause these prices to vary with respect to each other. One cut may have the call, with prices of other cuts ranging lower. For example, fancy bacon has been in heavy demand during the summer of 1920, and the price has not fallen with the price of hogs. But lard has dropped about 45 per cent at wholesale and dry salt pork has dropped about 35 per cent.

These prices are utterly beyond our control; bacon may come down at any time, and lard, or some other cut, go up.

But you may rest assured that competition, at all times keen and active, keeps the average return from all cuts down to a point which allows us less than one cent per pound on all pork products sold.

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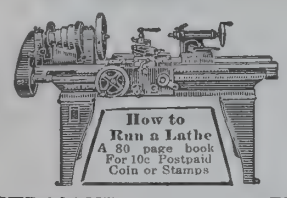


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in purchasing a can of olive oil, a housewife might be confused by encountering in the same grocery store cans of olive oil labeled "Sunlight" alongside of other cans of the same commodity labeled "Moonlight."

In practically all English-speaking countries except the United States there is a Trade-Mark Office separate from the Patent Office and a Registrar of Trade-Marks distinguished from and not in any way subordinate to the Commissioner of Patents. Moreover, in the majority of foreign countries, both the Patent and the Trade-mark Offices are a part of the Executive Department corresponding to our Department of Commerce, as for instance in England where these offices are in the Board of Trade and in Canada where they are in the Department of Trade and Commerce.

In connection with the establishment of a separate Trade-mark Bureau and a Registrar of Trade-marks, consideration might well be given to the question of placing in such bureau and under the authority of such official the present function exercised by the Bureau of Foreign and Domestic Commerce, of advising our manufacturers and exporters of the necessity of prompt and adequate protection of their trade-marks abroad, and of how to obtain such protection, and of calling to the attention of trade-mark owners apparent attempts to pirate their trade-marks in foreign countries as noted in foreign trade-mark gazettes, reports from commercial attachés, consular officers, etc. At present, the Bureau of Foreign and Domestic Commerce is handicapped in this work by insufficient knowledge of the ownership and status of the various trade-marks and trade-names; while the Patent Office, because of lack of familiarity with the necessities of export trade and of foreign trade-mark laws and practice, is unable to coöperate as it should in the protection of American trade-marks abroad.

## Twentieth Century Telegraphy

(*Continued on page 378*)

length, although each one sends a separate letter over the circuit, and as the entire operation is automatic there are no variations of any kind to disturb the impartial distribution.

The impulses received at the distant end from the sending distributor pass through a receiving distributor which switches them accurately to the various receiving typewriters. Here the impulses are translated by selector devices into action on the typebars, the result of each impulse being to strike the proper letter on the telegram blank. The two distributors are kept in perfect synchronism, resulting in perfect distribution, by "phonic wheels" or tuning forks. The impulses are caused in the first place by perforations punched in a type by a typewriter keyboard on which the operator "copies" the message to be sent. All this takes place at such a high speed that the capacity of one wire is raised as high as twelve thousand words an hour in each direction.

There are 24 trunk tubes which enter the main office from Market Street. The tubing is of pure copper, which resists electrolysis and chemical action, and also presents an ever smooth surface to the carriers. The longest single tube is one mile in length, the compressed air driving the cartridge message-containers through the tubes at a speed of 40 feet per second. The tubing used is in sections 15 feet in length. Big air compressors operate a combination pressure-vacuum circulating loop system, driving and pulling simultaneously. The tubes are laid with a drainage slope with special equipment for keeping the low spots clear of condensed moisture.

Entering the main San Francisco office are 2,000 wires containing the existing working circuits, spare facilities and provision for growth and extension. These wires terminate in a switchboard, the operation of which is by means of plugs and cords, which enable the various lines to be connected to different sending and receiving positions, to battery sources, etc.

## Taking on Oil a Mile at Sea

(*Continued from page 380*)

the connection made to the hose, six short blasts are blown on the siren of the vessel, this being a signal to "stand by." In answer to these six blasts the shore siren emits similar blasts. Then as soon as the mooring master is satisfied that everything is O. K. he blows one whistle from the ship. This is the signal to start pumping slowly from the shore and is immediately answered by the shore station. As soon as the pumping process has been completed the mooring master signals by three blasts from the ship's siren and the process is brought to a stop. The ship, now loaded, receives her papers, unmoors and gets ready to sail.

The world's largest tank steamer, the "Standard," whose capacity is 118,000 barrels has already been moored in one hour. The pumping was started forty minutes later, and the ship was loaded twenty-seven hours and fifty-five minutes later. An hour after the vessel sailed, making a total time in port of only thirty hours and twenty-five minutes, with an average pumping rate of 4,253 barrels an hour. This particular vessel was never loaded and dispatched in such quick time before.

As a rule, the crude oil is pumped from the shore tanks at its natural temperature. When greater speed in loading is desired the oil can be heated, but the sea water is warm and it rarely becomes necessary to increase the fluidity of the oil to enable the pumps to handle it.

## The Heavens in October, 1920

(*Continued from page 382*)

and rises at 3:20 A. M. in the middle of the month.

Uranus is in Aquarius, and observable all the evening. Neptune is in Cancer, and visible only in the early morning.

The moon is in her last quarter at 8 P. M. on the 4th, new at the same hour on the 11th, in her first quarter at 7 P. M. on the 19th, and full at 9 A. M. on the 27th. She is nearest the earth on the 4th, farthest away on the 18th, and at her nearest approach again on the 30th. During the month she passes near Neptune on the 7th, Jupiter on the 9th, Saturn later on the same day, Mercury on the 13th, Venus on the 14th, Mars on the 17th and Uranus on the 22nd.

At the present full moon a total eclipse occurs, which is invisible from the eastern United States, but partly visible in the western section of the country, and wholly visible throughout most of Asia and Australia. The moon enters the earth's shadow at 7:26 A. M. (eastern standard time), becomes completely immersed in it at 8:29, and gets finally clear at 10:57. From these data it is evident that during the whole eclipse the sun is above our horizon, and the (full) moon therefore below it. But since, in the latitude of 40°, which is taken as the basis of these predictions, the sun rises at 6:30 A. M., local standard time, on the day of the eclipse, it follows that, for points in about the longitude of Chicago, the moon will set just as the eclipse begins, while observers farther west will have a fine chance to see it. On the Pacific Coast, totality will begin well before sunrise, and the spectacle will be of real interest to the early riser.

Engng
SA

IN THIS ISSUE:

CONCRETE AND THE BUILDING CRISIS
PREVENTING RUST AT HIGH TEMPERATURES

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

PUTTING GRAVITY TO WORK IN THE ERECTION OF CONCRETE BUILDINGS.—[See page 398]

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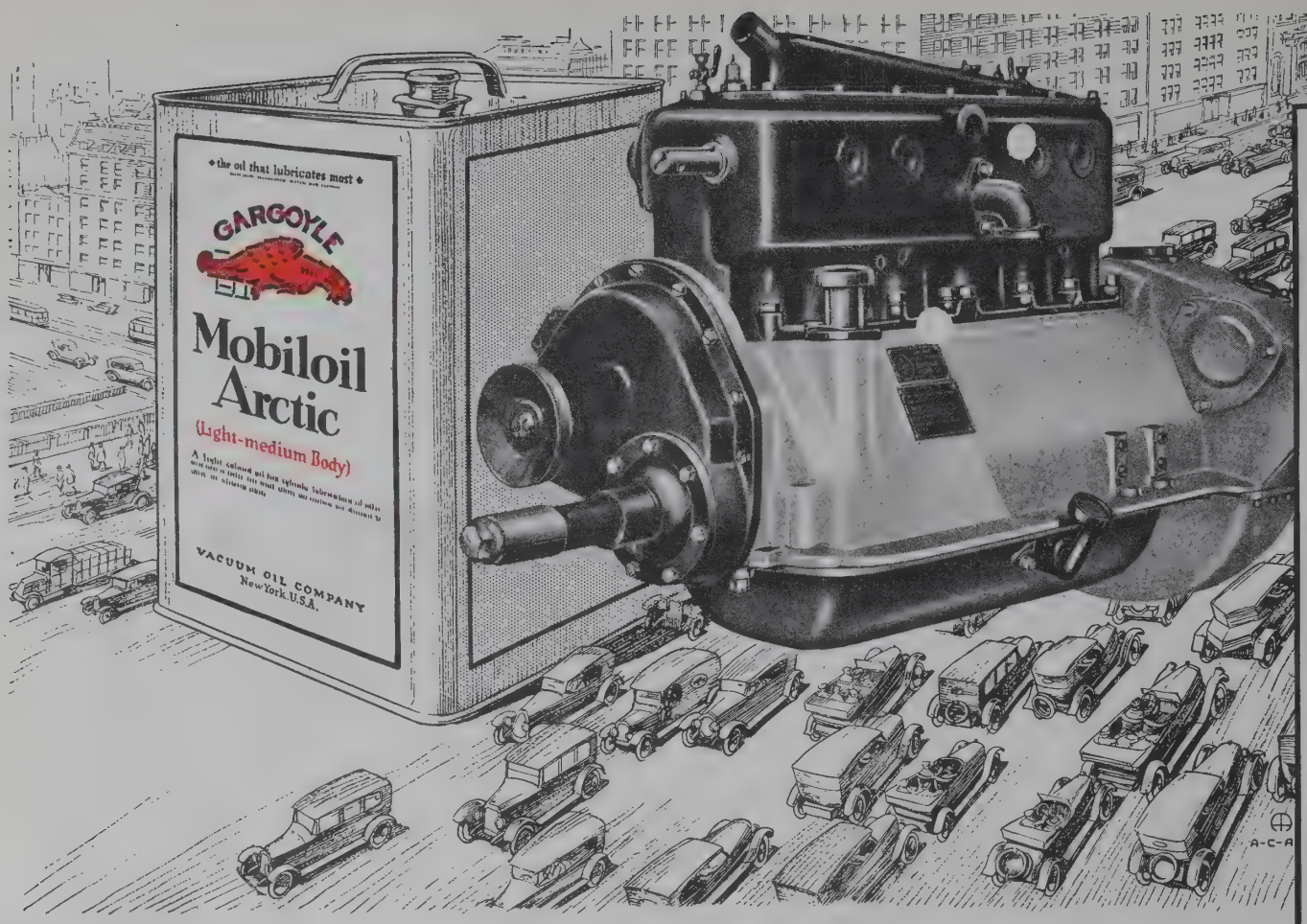



# FOR YOUR CONTINENTAL MOTOR

## *Three factors which explain the superior results obtained from Gargoyle Mobiloil Arctic*

IF you select a car with a Continental Motor you look for engine results. Continental Motors are the standard equipment today in nearly 200 models of passenger cars and motor trucks.

The most important single factor in the efficient operation of your engine is Correct Lubrication.

The Vacuum Oil Company's Board of Automotive Engineers has carefully analyzed the lubricating requirements of all types of Continental Motors and has determined the correct lubricant to meet these lubricating requirements with scientific exactness.

This correct lubricant is Gargoyle Mobiloil Arctic for all models except the "B-2" and "T" motors that are used in certain models of trucks for which the correct oil is Gargoyle Mobiloil "A."

SOME features of design and the conditions under which Continental Motors operate, influencing the choice of a lubricant, are:

1—Moderately high piston speeds.

2—Close-fitting pistons and well-finished cylinder walls, made possible by expert workmanship and exact production methods.

3—Well-jacketed, vertical cylinders, preventing excessive cylinder wall temperatures.

Taking these points into consideration, together with other important features of design and construction, an oil of the character and body of Gargoyle Mobiloil Arctic is best adapted to provide perfect cylinder lubrication, properly seal the piston rings against gas and fuel leakage, and minimize carbon formation.

In addition to meeting these cor ditions, Gargoyle Mobiloil Arctic is of the proper fluidity to be distributed through the lubricating systems in Continental Motors, providing adequate lubrication for every bearing surface.

With Gargoyle Mobiloil Arctic in your Continental Motor you will secure full power and the minimum cost per mile for gasoline, oil and repairs.

GARGOYLE

# Mobiloils

*A grade for each type of motor*

Domestic Branches: New York Boston Philadelphia Pittsburgh Detroit Chicago Minneapolis Indianapolis Kansas City, Kan. Des Moines

## Chart of Recommendations *for* AUTOMOBILES

(Abbreviated Edition)

GARGOYLE

# Mobiloils

*A grade for each type of motor*

### How to Read the Chart

THE Correct Grades of Gargoyle Mobiloils for engine lubrication are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

**These recommendations cover all models of both passenger and commercial vehicles unless otherwise specified.**

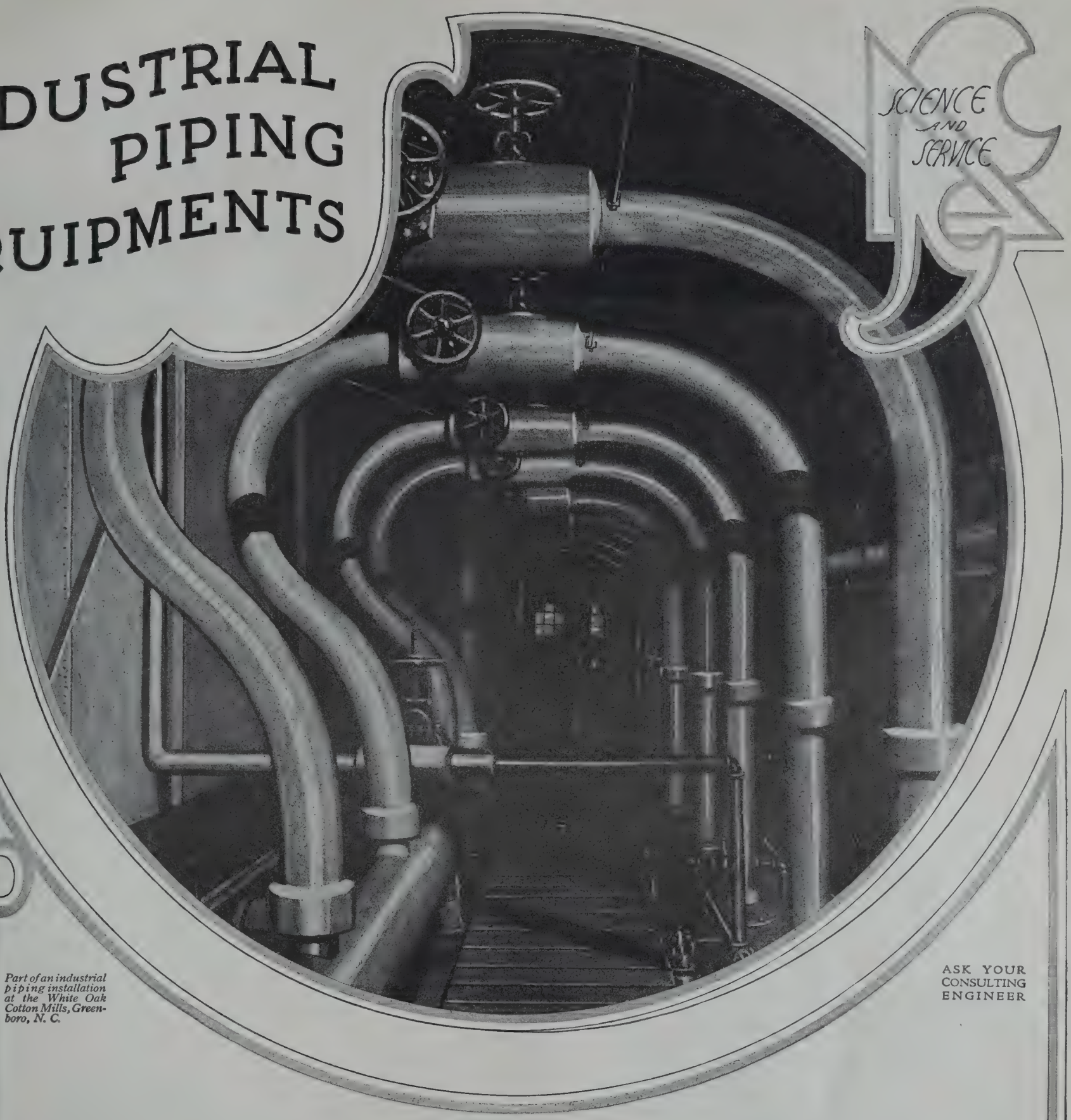
Where different grades of Gargoyle Mobiloils are recommended for summer and winter use, the winter recommendation should be followed during the entire period when freezing temperatures may be experienced.

This Chart is compiled by the Vacuum Oil Company's Board of Automotive Engineers, and constitutes a scientific guide to Correct Automobile Lubrication.

If your car is not listed in this partial chart, consult the Chart of Recommendations at your dealer's, or send for booklet, "Correct Lubrication," which lists the Correct Grades for *all* cars.

| 117 Weight A, B, Farm Dr. 3 Automobiles 1920 | 1920 | | 1919 | | 1918 | | 1917 | | 1916 | |
|---|---|---|---|---|---|---|---|---|---|---|
| NAMES OF AUTOMOBILES AND MOTOR TRUCKS | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| Allen | A | Arc. | A | Arc | A | Arc. | A | Arc. | A | Arc. |
| Atlas | A | Arc. | A | Arc. | A | Arc. | A | Arc | . | . |
| Bessemer | Arc | Arc | Arc. | Arc | Arc | Arc. | Arc. | Arc. | Arc. | Arc. |
| Biddle | A | Arc. | A | Arc | A | Arc | A | Arc | A | Arc |
| Buick | Arc. | Arc | Arc | Arc | Arc. | Arc | Arc | Arc | Arc. | Arc. |
| Cadillac | A | A | A | A | A | A | A | A | A | A |
| Chalmers (6-48) | . | . | . | . | . | . | . | . | Arc. | Arc. |
| " (6-40) | . | . | . | . | . | . | . | . | A | Arc. |
| " All Other Models | A | A | A | A | A | A | A | A | A | A |
| Chandler Six | Arc. | Arc | Arc. | Arc. | Arc. | Arc. | Arc. | Arc | Arc | Arc. |
| Chevrolet (8 cylinder) | . | . | A | A | A | A | A | . | . | . |
| " (FA) | . | . | A | Arc. | A | Arc. | . | . | . | . |
| " (FB & 1 ton) | A | Arc. | . | . | . | . | . | . | . | . |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc | Arc | Arc | Arc | Arc | Arc. |
| Cleveland | A | Arc. | . | . | . | . | . | . | . | . |
| Cunningham | A | A | A | A | A | A | A | A | A | A |
| Dixie Flyer | A | Arc | A | Arc | A | Arc | A | Arc | . | . |
| Dodge Brothers | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Essex | A | Arc | A | Arc | . | . | . | . | . | . |
| Federal (Model S-X) | . | . | . | . | A | A | A | A | . | . |
| " (Special) | . | . | . | . | Arc. | Arc. | . | . | . | . |
| " All Other Models | Arc | Arc | Arc | Arc. | A | A | Arc | Arc | Arc | Arc |
| Ford | E | E | E | E | E | E | E | E | E | E |
| Franklin | A | A | A | A | A | A | A | A | A | A |
| G. M. C. Trucks | Arc | Arc | Arc | Arc | Arc | Arc | Arc. | Arc | Arc | Arc |
| Grant (6 cylinder) | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| " (Com.) (Model 12) | . | . | A | Arc | . | . | . | . | . | . |
| " ( " ) All Other Models | Arc | Arc | Arc | Arc | . | . | . | . | . | . |
| Haynes (6 cylinder) | A | Arc. | A | Arc | A | Arc. | A | Arc | A | Arc |
| " (12 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Holmes | B | A | . | . | . | . | . | . | . | . |
| Hudson Super Six | A | Arc | A | Arc | A | Arc | A | Arc. | A | A |
| " All Other Models | . | . | . | . | . | . | . | . | Arc | Arc |
| Hupmobile | A | Arc | A | Arc | A | Arc | A | Arc | A | Arc |
| Jones | Arc | Arc | Arc | Arc | Arc | Arc | A | Arc | A | Arc |
| Jordan | Arc | Arc | Arc | Arc | Arc | Arc | Arc | Arc | . | . |
| King (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Kissel Kar (Model 48) | . | . | . | . | . | . | . | . | A | A |
| " " (12 cylinder) | . | . | . | . | A | A | A | . | . | . |
| " " All Other Models | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Liberty | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | . | . | . |
| Locomobile | A | E | A | E | A | E | E | E | E | E |
| Luverne | . | . | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc |
| Maccar (5½ ton) | A | A | A | A | A | A | Arc. | . | . | . |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Marmon | A | A | A | A | A | A | A | A | A | A |
| Maxwell | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Mercer | A | A | A | A | A | A | A | A | A | A |
| Mitchell (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc |
| " (8 cylinder) | . | . | . | . | . | . | . | . | A | A |
| Moline-Knight | . | . | B | A | B | A | A | A | A | A |
| Monroe (Model M 2) | . | . | . | . | . | . | . | . | E | E |
| " ( " M 3) | . | . | . | . | A | Arc. | A | Arc. | . | . |
| " All Other Models | A | A | A | A | A | A | A | . | . | . |
| Nash (Quad) | A | A | A | A | A | . | . | . | . | . |
| " (Model 671) | . | . | . | . | A | A | . | . | . | . |
| " All Other Models | A | Arc. | A | Arc. | A | Arc. | . | . | . | . |
| National (6 cylinder) | A | A | Arc. | Arc. | Arc. | Arc | Arc | A | Arc. | . |
| " (12 cylinder) | . | . | A | A | A | A | A | A | A | A |
| Nelson | . | . | A | A | A | A | A | . | . | . |
| Noble | A | A | Arc. | Arc. | Arc. | Arc | Arc | . | . | . |
| Oakland (8 cylinder) | . | . | . | . | . | . | . | . | A | A |
| " All Other Models | A | A | A | A | A | Arc. | Arc | Arc | Arc | Arc |
| Old Hickory | Arc | Arc | Arc | Arc | A | Arc. | A | Arc | A | Arc |
| Oldsmobile (4 cylinder) | A | Arc | A | Arc. | . | . | . | . | Arc. | Arc |
| " (6 cylinder) | A | A | A | A | A | Arc | Arc. | . | . | . |
| " (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Oshkosh | A | Arc | . | . | Arc. | . | . | . | . | . |
| Overland | A | Arc | Arc | Arc. | Arc. | Arc | Arc. | Arc | Arc | Arc |
| Packard | A | A | A | A | A | A | A | A | A | A |
| Paige (6 cylinder) | A | Arc | A | Arc. | A | Arc. | A | Arc. | A | Arc |
| " (Cont. Eng.) | Arc | Arc | Arc | Arc. | Arc | Arc | Arc. | Arc | Arc. | Arc. |
| " All Other Models | A | A | . | . | . | . | . | . | . | . |
| Pan (Model A) | A | Arc. | A | Arc. | A | Arc. | . | . | . | . |
| " (Model 250) | . | . | . | . | Arc. | Arc. | . | . | . | . |
| Peerless (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| " All Other Models | . | . | . | . | Arc | Arc | Arc | Arc | Arc | Arc |
| Pierce Arrow | A | A | A | A | A | A | A | A | A | A |
| " (Com.) (5 ton) | A | A | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " ( " ) All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Premier | A | A | A | A | A | A | A | A | A | Arc. |
| R & V Knight | B | A | . | . | . | . | . | . | . | . |
| Reo | A | Arc. | A | Arc | A | Arc | A | Arc | A | Arc. |
| Riker | A | E | A | E | A | E | E | E | . | . |
| Rock Falls | A | Arc | A | Arc. | . | . | . | . | . | . |
| Sanford | Arc. | Arc. | Arc. | Arc. | A | A | Arc | A | A | Arc. |
| Saxon | . | . | E | E | E | E | E | E | E | E |
| Scripps-Booth (4 cylinder) | . | . | . | . | Arc. | Arc. | A | Arc. | A | Arc |
| " (6 & 8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Stearns-Knight | B | A | B | A | B | A | A | A | B | A |
| Studebaker | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Stutz | A | A | A | A | A | A | A | A | A | A |
| Templar | A | A | A | A | A | A | . | . | . | . |
| United (Grand Rapids,) (2½ ton) | A | A | A | A | A | A | . | . | Arc | Arc. |
| " " " (3½ ton) | A | A | A | A | A | A | Arc. | Arc. | Arc. | Arc. |
| " " " (4 ton) | . | . | A | A | . | . | A | A | . | . |
| " " " (5 ton) | A | A | A | A | A | A | A | A | A | A |
| " " " (6 ton) | . | . | A | A | . | . | . | . | . | . |
| " " All Other Models | A | A | A | Arc. | A | Arc. | Arc. | Arc | Arc | Arc |
| Velie (4 cylinder) | A | Arc. | . | . | . | . | . | . | . | . |
| " (6 cylinder) | Arc | Arc. | Arc | Arc. | Arc | Arc. | Arc | Arc | Arc | Arc |
| " (Com.) (3 ton) | . | . | A | Arc | A | Arc. | . | . | . | . |
| " " All Other Models | Arc | Arc. | Arc. | Arc | Arc. | Arc. | . | . | . | . |
| Vim (Models 22, 23 and 24) | A | A | A | A | . | . | . | . | . | . |
| " (Model 25) | A | A | Arc | Arc. | . | . | . | . | . | . |
| " All Other Models | Arc | Arc. | Arc. | Arc. | Arc | Arc. | Arc | Arc | Arc | Arc. |
| Westcott | Arc. | Arc. | Arc. | Arc | Arc. | Arc. | Arc | Arc. | Arc. | Arc. |
| White (16 valve) | . | . | A | A | A | A | A | . | . | . |
| " (3 ton) | . | . | A | A | Arc. | Arc. | . | . | . | . |
| " All Other Models | . | . | Arc. | Arc. | Arc. | Arc. | Arc | Arc. | Arc. | Arc. |
| Willys-Knight | B | A | B | A | B | A | A | A | B | A |
| Willys Six | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | . | . |
| Winther Six | A | Arc. | . | . | . | . | . | . | . | . |
| " (Com.) | A | A | A | A | A | A | A | . | . | . |
| Winther-Marwin (1½ ton) | A | A | Arc. | Arc. | . | . | . | . | . | . |
| " " All Other Models | A | A | A | A | . | . | . | . | . | . |
| Winton | Arc. | Arc. | Arc. | Arc | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |

# INDUSTRIAL PIPING EQUIPMENTS




*Part of an industrial piping installation at the White Oak Cotton Mills, Greensboro, N. C.*

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## Decades of Experience

FOR seven decades Grinnell engineers have been solving the intimate engineering problems that surround the design and erection of industrial piping equipments. Our whole organization has been built up to render a unique service in such work. If you have an industrial piping project of any kind we believe you will find it profitable to consult with us. Our experience covers:

Automatic Sprinkler Systems Steam, Hot Water and Gas Heating Power and Related Piping Process Piping of all kinds
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Gordon Dryers Safety Fuel Saver Constant Level Size Circulating Systems Piping for Acids and Alkalies

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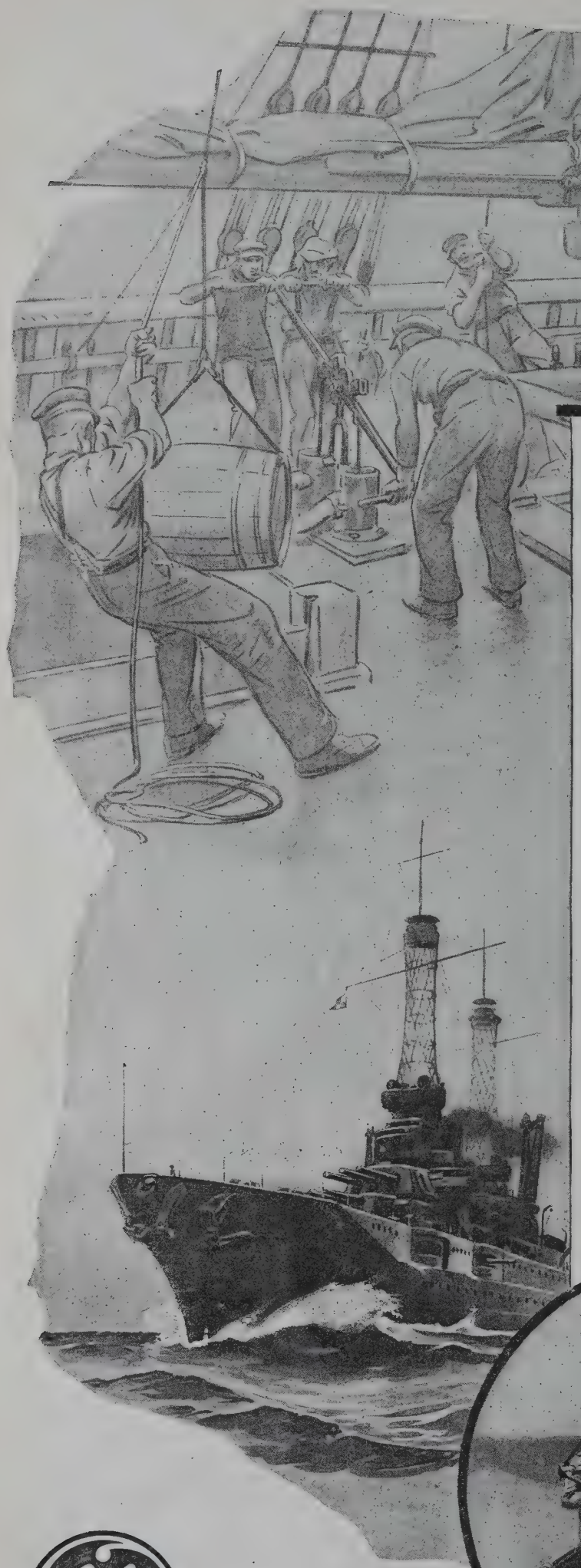


## *Life on the Ocean— with Electricity at the Helm*

IN the old days before the mast, weighing anchor, pumping ship, and "keeping her before the wind" were tasks for brawny men who knew neither fear nor fatigue.

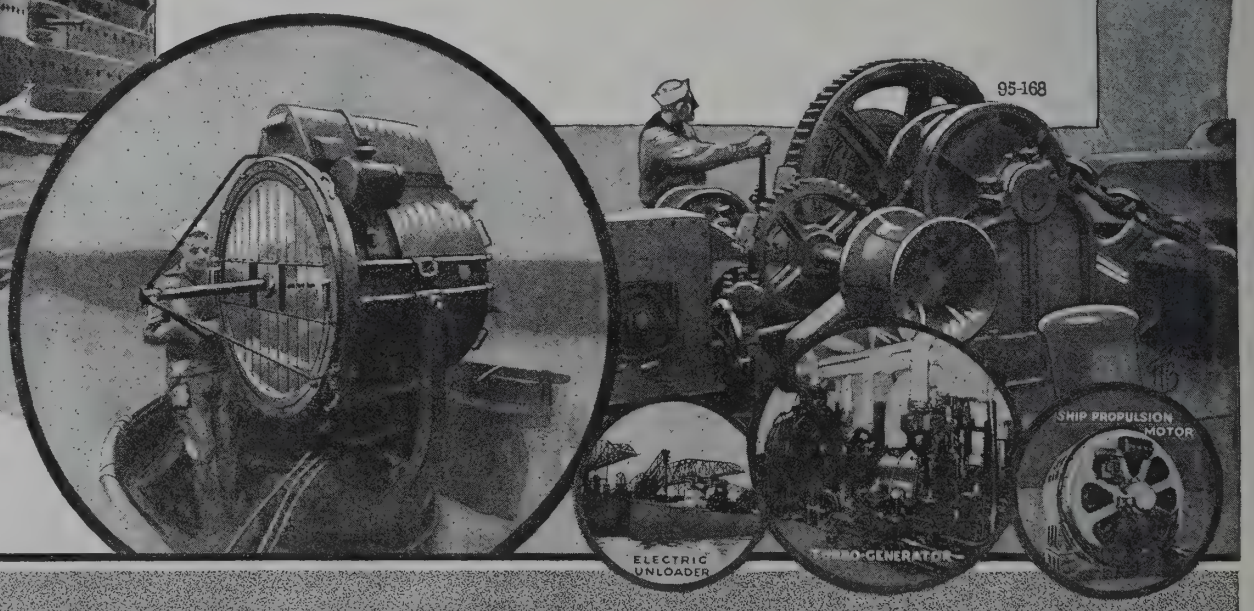
The old sea was rated in terms of man power, while the new sea is measured in horse power, with electricity as the controlling force. Imagine a great electric city afloat, where tasks are simplified, where safety is assured, and where convenience and comfort are present at every turn. Such is the modern electric ship; the New Mexico or the California for example. Electricity is the source of all things good from stem to stern.

With oil for fuel, a central power plant generates sufficient energy to propel the massive vessel, to furnish light for every purpose, and power for every need. Searchlights, signals, steering apparatus, wireless telegraphy, pumps, capstans, winches, hoists, cranes, drills, welders, rivet heaters, cooking appliances, and a hundred other devices for making work easy and protecting human life—all with one source of power that is safe, clean and *always available instantly*.

Whether at sea or in port, the work of a sailor and the comforts of a passenger are enhanced by the proper application of electricity. Cargoes are loaded and unloaded quickly and efficiently. Repairs are facilitated, and the ship is kept in active service over longer periods, thus aiding commerce and world distribution to a marked degree.

Such a development has not been simply a question of designing and building the necessary equipment for marine electrification. It has devolved upon some manufacturer to look well into the future and visualize the needs aboard ship, and then to engineer the machinery into those needs. In this capacity the organization, experience and facilities of the General Electric Company are serving the American Navy and the American Merchant Marine.






GENERAL ELECTRIC COMPANY

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

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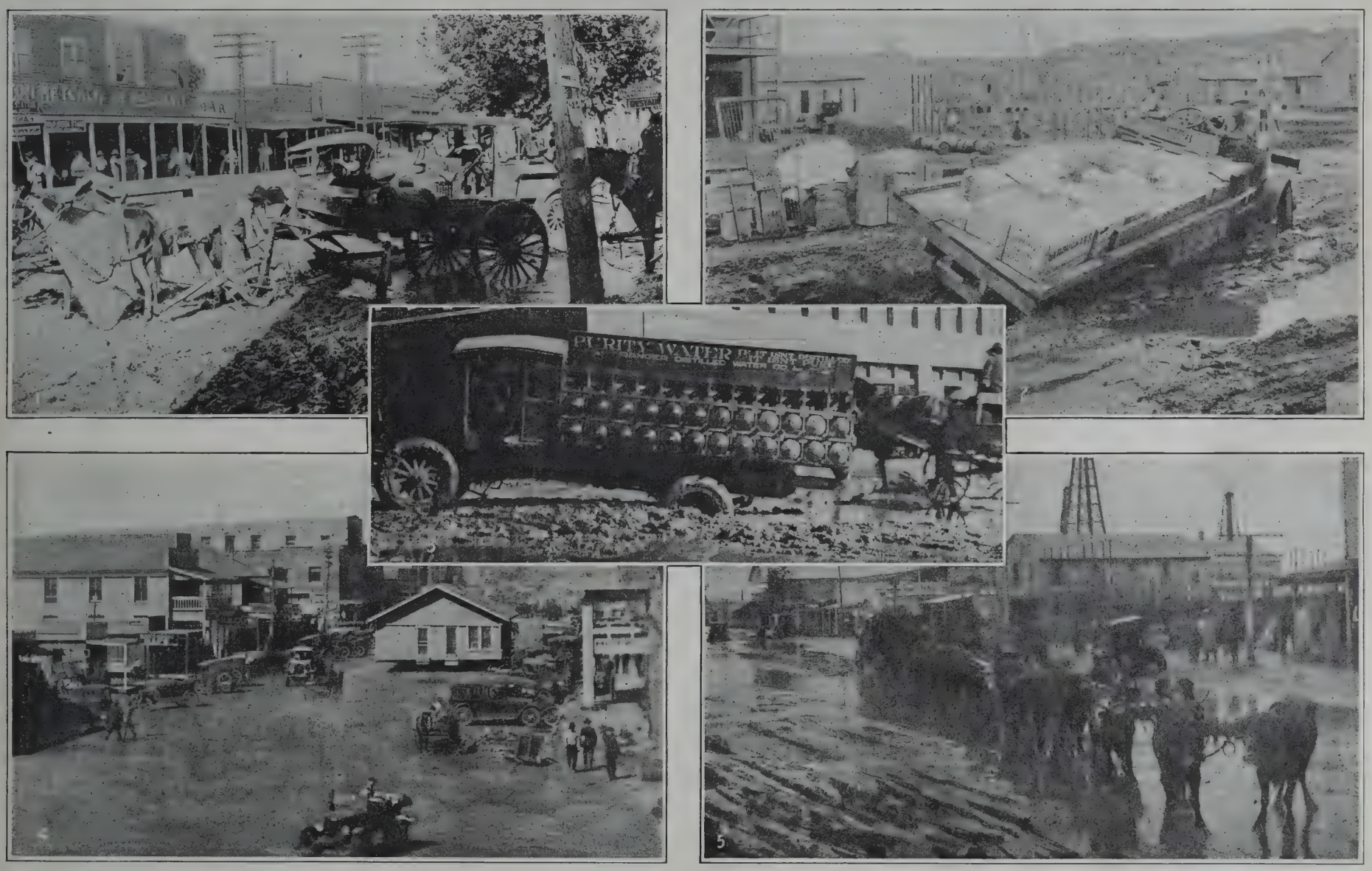


1. A typical oil town showing conditions under which motor traffic is at a discount. 2. Big truck stuck in the mud of a main street. 3. Making heavy going of it in the Burkburnett field. 4. The main street of a big oil boom-town. 5. Desperate remedies that are resorted to, to restore traffic

**Representative scenes in the mud roads and streets of the Texas oil district, showing some of the transportation difficulties that add to the price of petroleum products**

## Transportation in the Oil Fields

**By Edmund Conaway**

IN the great oil fields of the country there are many different forms of transportation. In the mountainous districts of the country most of the hauling within the fields is done by teams, while within the more level country it is done by trucks, tractors and caterpillars. I do not mean to leave the impression that no teams are used in a level country, because in a great oil field there is plenty of hauling for all. In the great fields of the Southwest there are thousands of teams and trucks. I remember one day having passed seven hundred teams upon a road connecting two towns, thirty-five miles apart. One of these was a shipping point and the other was the center of a large oil field. Upon this same road were many trucks, also tractors and caterpillars. In good weather trucks are always busy and occasionally some teams are idle on this account, but in bad weather the teams do the greater part of the hauling.

Trucks and trailers of every make are used. It is a common sight in Central Texas to see a tractor pulling a boiler and two wagons loaded with casing. The expense of transportation is greatly due to the distance material must be hauled and to the bad roads. It is estimated that where the depth of wells is at least 3,200 feet the cost of hauling material by teams and trucks will average $8,000.

The roads throughout the oil fields of the Southwest have been very bad. At times the only hauling that can be done is by horses, mules and oxen, and often but few teams will venture out. In traveling upon the main roads it is a common sight to see trucks, cars of all makes and wagons stuck in the mud. Ordinarily trucks and teams travel together in order to help one another. Upon one occasion when a driver with four mules got stuck in the mud, it being almost dark with no help near, feeling that his animals were safe he went away and staid until morning.

One man is not bothered by bad roads—the owner of the airplane. A few wealthy men of the West and Southwest visit their holdings in this manner. At Casper, Wyoming, last summer an agency was established to sell airplanes to wealthy oil and cattle men.

These great trucks and tractors are extremely hard on roads. In order for one to have some idea of the roads either in dry or wet weather it is necessary to travel over them. In dry weather they are extremely rough and in wet weather they are lakes of water and mud.

The streets are often excellent examples of the muddiest oil field roads, due to much heavy hauling and rain. In 1919 there was a great deal of rain. I have often seen a team stall on the main street in oil towns and horses and mules down in the mud. In one instance I saw a mule down in a mudhole in front of the railroad station at Ranger.

Gum boots are very popular among men and women. In Ranger in order to cross the streets a form of sled was devised pulled by one horse. These were stationed at different corners and anyone could be set across the street for a dime.

Many mules and horses are used in the oil fields of the Southwest. The care and treatment of animals there is poor as compared with that given in northern fields. They are fed enough, but are given little thought as to shelter, grooming and bedding. What grooming the animals receive is given with a whip.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## The Gordon-Bennett Airplane Race

ALTHOUGH the failure of the special American racing machines to be placed in the recent Gordon-Bennett Challenge cup race in France was a keen disappointment, there are several outstanding lessons to be learned which, if laid to heart, should enable us to win, or at least come very much nearer to victory, in any future international contest.

The outstanding fact is that, as compared with the winning French machines, our own were comparatively untried, or, to borrow a yachting term, they had never been properly "tuned up." In commenting on the recent America's Cup contest, we emphasized the fact that until "Shamrock" met "Resolute," she had had no opportunity to test herself against an up-to-date racing yacht of her own type. Everyone knew that she was fast, but just how fast she would be over the Sandy Hook course against a yacht that had tuned up in American waters was not known. The American defender, on the contrary, had gone through three seasons of exhaustive trials against a yacht, the "Vanitie," which was just about as able as herself.

Similarly, when the three American machines started in the Gordon-Bennett race, they were not only flying around a circular course with which they were quite unfamiliar, but they found themselves matched against French machines that were thoroughly at home on the course and knew exactly what they could do in hugging the many turning points by resorting to steep and all-but-vertical banking. It is probable that, on a straight-away course, the American racers were faster than their French and British competitors; and had they been thoroughly well tuned up and had the course been a straight-away, we think that they would have won. But flying with the engine wide open on a straight course and flying at full power and speed around a circular course are two very different things. At a speed of approximately 170 miles an hour, it takes skill, familiarity with the turns, and absolute confidence in the strength of the wings, to make a close turn.

It is a noteworthy fact that all three of the French contestants were biplanes of a standard type, engined with standard motors. The only direction in which they departed from normal was that they carried somewhat less wing surface than the standard military machines. The winning Nieuport covered the three laps of the 300-kilometer course at a speed of 168.4 miles per hour, which is a long way below the 200 miles an hour which was freely predicted as the speed of our own and the French machines.

The three American contestants were described in our issue of September 11th. The most powerful was a Verville-Packard biplane, equipped with a 500-horse-power Liberty engine. The other two were monoplanes —a Curtiss machine equipped with a 400-horse-power engine, and a Dayton-Wright monoplane with retractable landing gear, equipped with a 250-horse-power engine. All three machines were credited with having made 200 miles an hour and over on straight-away flights. In each one, weights had been cut down to a minimum, and wing surface had been reduced to the lowest possible figure consistent with safety. None of the machines was equipped with shock absorbers in the landing gear, and all of them, because of the great engine power in proportion to wing surface, had high landing speeds.

It was these features which cost the Curtiss monoplane dearly, because when making a landing the gear, unable to stand the impact, crumpled and the machine was wrecked. The Verville-Packard biplane was put out of the race early by engine trouble, the result, it is said, of overheating due to radiator failure. The beautiful little Dayton-Wright monoplane had to come down because of failure of the steering gear, one of the rods, according to the pilot, having become bent and the machine being out of control. It is possible that, at the very high speed developed, the nascelle proved to be too short to allow of a free flow of air to the rudders, or, to put it another way, the latter did not possess sufficient area for satisfactory control. This last, however, is mere conjecture.

It should be understood that what we have said above is not at all to be considered as excuses for our failure. The flying field was a representative French flying field and the difficulties of landing and taking off were alike for all.

## Einstein Contest Information

INQUIRIES about the Einstein contest having brought out several points not completely covered by the published rules, we take this opportunity to make these points clear.

The greatest concern seems to be about the precise style in which words are to be counted. Compound words, when properly used and hyphenated, will count as single words. Algebraic expressions standing for single numbers or ideas will likewise go as single words. This applies to the single letters $x$, $y$, $z$, $t$, etc., when used singly; also to such items as the functional notation $F(x, y, z, t)$ and the radical giving the value of the Einstein correction factor. Under this convention equations will count as three words—one for each member and one for the sign of equality. If mathematical notation is employed which seems to the Einstein Prize Essay Editor to fall under neither of these specifications, he will use his best judgment in applying the spirit of the convention that a word stands for an idea.

The main title will of course not figure in the word-count. But some contestants will wish to use a sub-title, sub-heads scattered through the text, etc. In view of the fact that every competing essay is a prospective contribution to the SCIENTIFIC AMERICAN, it seems proper to set our own typographical style as a standard. Sub-titles must go in on a single line of a three-column head, as seen on page 398. A sub-head may occupy no more than two lines of a single column, as seen, among other places, in our monthly articles on the Heavens; and sub-heads should average more than 500 words apart. Subject to these requirements, sub-title and sub-heads may be used and will not figure in the word count. Such fixtures when longer than thus contemplated will be counted in full, on the theory that they have been used to relieve the text of part of the story.

Many contestants will desire to illustrate their text with drawings, diagrams, etc., which may require captions. These will be regarded as part of the picture and will not be counted, unless it appears to the Einstein Editor that they have been used to relieve the text. The best way to meet this possibility is substantially to duplicate the caption in the text; but we offer this as a suggestion, not as a requirement. When the spirit of the law is violated the entire caption will be counted as part of the text.

Anything whatever in the nature of a preface or prolog, an appeal to the judges, an apology for or statement of the viewpoint of the essay, whether intended to be printed as part of the essay or not will be considered as part of it and included in the word count.

The point has been raised whether a single competitor may submit more than one essay. We know no reason why he should expect such diffusion of effort to work to his advantage, but if he does not agree with us, we shall have to allow him to submit as many essays as he pleases. We will not open the envelopes giving any name and address until after the award of the prize; so we will not be aware of multiple efforts and could not rule them out if we would. We must require, however, that when one man submits multiple essays he submit a separate identifying envelope with each, and sign a different pseudonym to each.

A few suspicious souls have asked how they can be sure that their essays reach us, since registering the package involves writing on it the name and address of the sender. Such registration is not contrary to the rules; the outer wrapper is destroyed as soon as opened, leaving no record of the sender's identity. If you do not credit us with good intentions to this extent you would best stay out of the contest.

A very delicate question has been raised by several eminent gentlemen who have already appeared in the public prints on the subject of relativity, and who wish to know whether they may use parts of their own previously appearing work in their essays. Our whole impulse is to say "yes," but there is an operating detail which almost forces us to say "no." The essays will go to Professors Page and Adams anonymously. Any material use of previously published matter will hardly escape them, for they may be assumed to be familiar with the literature. In the event that they recognize the old material, they must conclude either that the essay using it is by the original author, which would destroy its anonymity, or that the passage has been deliberately appropriated by another, which would bar the essay even if quotation marks and acknowledgment of source were employed.

It may be necessary to supplement the last paragraph with a word of reassurance. Where words are property, ideas are not. No contestant need fear to incorporate in his essay an idea which he has found in a published book or article, if he gives it new form in his own words. But direct quotation, even with acknowledgment, unless it be of a mere catch phrase, will not do.

## Doubling the New York Subway System

DEARLY bought experience has shown the need for faith and foresight in providing for the future transportation requirements of large cities. This is true both of the authorities and of the public. It was the lack of clear vision and courage that so greatly delayed the commencement of the New York subways, and we are suffering the penalty of that irresolution in the present intolerable congestion of our subways. We did much better when it came to the question of doubling our facilities by the construction of the so-called Dual System; but the astonishing way in which the new lines were crowded with passengers within a few days after opening proves that, even then, we did not look far enough ahead and that we failed to perceive the accelerated rate at which subway travel was advancing.

There is nothing of timidity, however, in the bold plans for enlarging our present subway system to meet the demands of the future which the Transit Construction Commissioner has recently published. Additional trunk lines are to be built running north and south under the avenues, and these are to be associated with crosstown lines, the whole new system being located with a view to rounding out and relieving the existing system.

It is gratifying to note that on some of the proposed crosstown lines, use is to be made of the continuous moving platform. This admirable device proved its great passenger-carrying capacity as long ago as the date of the Chicago Exposition, and we believe that it will prove to be admirably adapted for a rapid distribution of the crowds which will be unloaded at certain transfer points from the north and south subways. There is no known or conceivable method of local transportation which competes with it in its flexibility and in the number of passengers that can be carried within a certain time and within certain restricted distances. The moving platform, of course, cannot compete with a fast express service; it is not intended to. But for local service it is unsurpassed, and we hope that the conservatism and lack of vision which prevented its adoption when the last addition was made to our subway service, will fail to shake the Transit Construction Commission in its determination to include one or more moving platforms in the contemplated enlargement of the system.

# Forty Centuries Ago—And Now

## Why Should We Not Make Paper Again from the Papyrus?

By M. Tevis

IN the present world-wide shortage of paper it is not strange that in the search for new materials some attention should be paid to the remarkable plant which was first employed for this purpose and from which paper takes its very name. The papyrus reed or *Cyperus papyrus* was first used in Egypt, for the making of paper. The Egyptians in fact made many uses of this remarkable plant growing in the shallow waters of the Nile. The main root of the plant, which is about as thick as a man's wrist, lies in a horizontal position, while smaller roots extend downward from it into the mud and the stem rises into the air. These stems are triangular and tapering in shape and bear a picturesque tuft or umbel at the top which was compared by Pliny to a thyrsus, the crowned and garlanded staff borne by devotees of Bacchus in their revels.

This tufted head was used for the making of garlands wherewith to crown the images of the gods and wreathe their shrines. The root was used to make various utensils as well as for fuel. The pith contained in the stem was a common article of food both raw and cooked. The great value of the plant, however, lay in the stem; this is commonly six to ten feet long and a recent British investigator declares that along the upper Nile, where the plant still grows, though it is now extinct along the lower Nile, the stems often exceed fifteen feet in length. From this stem not only writing material was made but also cord, rope, and cloth, mats, sails, and boats. A certain piece of sculpture has been found belonging to the fourth dynasty, in which men are shown building a light skiff with stems cut from a neighboring plantation of papyrus. Some authorities indeed believe that the bulrushes mentioned in the Bible were really papyrus plants.

For the purpose of making paper the triangular stem was cut into longitudinal strips, those from the center of the plant being the broadest and most valuable. These strips were placed side by side on a board, forming a layer of suitable width, which was then covered with another layer of shorter strips laid at right angles. The sheet thus formed was soaked in the waters of the Nile, which caused the two layers to adhere firmly to each other, probably from deliberation of some sort of glutinous matter in the substance of the stem itself. The sheet was then pressed and dried in the sun, afterwards being polished with oil of cedar by means of ivory or a smooth shell. To form a roll the sheets were joined together with paste (glue being too hard).

The use of papyrus spread from Egypt to Greece and Italy and thence over Europe; it was finally superseded by vellum but did not entirely disappear until about the twelfth century.

Of recent years the papyrus plant has been freshly studied by English, French, and German authorities. In a late report made by certain British investigators it is stated that for a distance of three hundred miles along the upper Nile, it is at times exceedingly difficult to keep the main channel clear because of the enormous quantities of papyrus and other water plants which choke it, while all the tributary streams in this region are blocked for many miles. This dense vegetation is known by the general name of "sudd," and experienced observers estimate that it covers not less than 5,000 square miles, forming an immense store of valuable material either for fuel or for other purposes. It is estimated, indeed, that there is a store of 144,000,000 tons of sudd in this area. Employed as fuel this would be equal to 28,000,000 tons of coal and would be capable of yielding an amount of horsepower equal to about three-fourths of the theoretical average power of Niagara Falls.

But this material is also capable of yielding rope fiber and paper pulp, while the ash contains so much potash as to form a valuable fertilizer. Crude paper pulp, known in the trade as "half stuff" is readily obtainable, according to experiments made by an English chemist, by heating the papyrus stem either green or dry under pressure, to about 150 degrees Centigrade with water alone, no caustic soda or other chemicals being required. The air-dried papyrus yields about forty per cent of dry "half stuff" and about twenty per cent of dried bleached pulp. The paper made from this pulp is of very fine quality. Still more recent research at the laboratory in Khartoum shows that papyrus stems, when treated with hot water, under a pressure of about four atmospheres, yield practically all their mineral matter and most of the protein to the solution, while the residue constitutes very satisfactory crude paper pulp.

According to French students of the same subject papyrus pulp is very fine, slightly resembling that made from alfalfa. The fibers of the papyrus are regular and cylindrical and very fine and short, having tapering ends and a central canal one-third the width of the fibers. There are immense fields of papyrus in the French colonies of West Africa, especially in the delta of the Congo, and it is believed that when there are sufficient facilities in the way of railroads and labor, this material will be drawn on heavily.

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### Saving Wear on Shoe Soles

To the Editor of the SCIENTIFIC AMERICAN:

I note in your issue of July 31 last an article relative to a process for saving wear on shoe soles. I think I can go the writer one better by suggesting that copal or dark varnish be used in place of vaseline or oil. Apply as many coats as soles will soak in. Have found that this will make the soles outwear the uppers.

Old Mystic Ct. W. H. F. HANKS.

### The Horizontal Rainbow

To the Editor of the SCIENTIFIC AMERICAN:

I recently noticed a phenomenon of light while flying for which I do not derive a satisfactory explanation. I will be pleased to learn the proper explanation from yourself or from a reader of the SCIENTIFIC AMERICAN.

The phenomenon consisted of a rainbow in the form of an ellipse, a rather elongated ellipse. It occurred while I was flying around a small rainstorm and showed up on a low hanging mass of rain and water vapor some two thousand feet below me; it, of course, moved as I moved in the plane, and remained very bright for some two or three minutes. To give the details of the light direction I will mention that it occurred in the latter part of June about three o'clock in the afternoon in the latitude of Houston, Texas. I was flying in an easterly direction and the major axis of the ellipse seemed to lie in a line pointing a few degrees east of north, the ellipse lying to the north of my path, and as nearly as I was able to estimate it the shadow of my plane fell on what would be the southern focus, i. e., the focus nearest the plane, the red end of the spectrum being on the inside.

I trust that this may be of interest to some of your readers and thank you in advance for any light which you or they may be able to throw upon the phenomena.

RUFUS RIDDLESBARGER.

[*This is a case of the horizontal rainbow, formed by a more or less horizontal sheet of water drops below the level of the observer's eye. Such bows are seen upon a layer of cloud from a mountain summit or from aircraft, but those that have heretofore been observed and discussed in detail have generally been seen over bedewed fields or a thin sheet of fog near the ground or water, or in droplets deposited on a layer of oil floating on the water. The horizontal bow is circular only when the sun is overhead; at other solar altitudes it is elliptical, parabolic or hyperbolic. This feature is well explained with a diagram by Dr. Otto Klotz in the Journal of the Royal Astronomical Society of Canada, September,* 1917, *p.* 294 *ffg. Another explanation appears in Nature, March* 1, 1916, *p.* 5. *A résumé of several observations of horizontal rainbows appears in the Monthly Weather Review (Washington, D. C.), Feb.,* 1916, *p.* 65.—THE EDITOR.]

### Protecting Trees from the Sun

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue I noted the article regarding the desirability of protecting trees when transplanted from the effects of the hot sun. This has been known and the practise of protection systematized here, the common usage being either to loosely wrap the young trunk with a heavy grade of wood veneer tied with wire, or to nail a couple of six-inch boards into a V-shape and to drive these down a couple of inches from the tree so as to permit of ventilation while protecting the bark from the southwest sun. These schemes are both inexpensive, easily applied and readily removed when the tree is established.

St. Louis. A. BLAIR RIDINGTON.

### Metering Liquids

To the Editor of the SCIENTIFIC AMERICAN:

In a recent issue you carried a description of a "device for measuring the flow of liquids," stating that this was put out by an English firm. This description appears to be of an instrument which has been manufactured for the past ten years by my firm, and which has found wide application not only in the field of water measurement, but in the chemical industries and in the manufacture of paper as well. I hope you will agree with me that in fairness to our company you ought to make this clear to your readers.

Philadelphia. L. G. CHASE.

### Saving Gas

To the Editor of the SCIENTIFIC AMERICAN:

Your timely editorial, "How Many Miles to the Gallon?" in your issue of September 4th, if answered by many drivers who are making good mileage, telling how they do it, might lead to economizing results both in driving and in making autos. I have been trying out an idea, not a new one by any means, and the result has convinced me that at least one kind of carburetor is wasteful of gasoline, and also that there should be an authoritative test of all carburetors, and all condemned that do not come up to a certain standard. The idea referred to is the admission of air to the manifold for which purpose I use a quarter-inch pet-cock with a rod connected to same and extending through dash, giving control of amount of air admitted from driver's seat. My car when running on the leanest practicable mixture with pet-cock closed, will reach its greatest speed with cock about half open, but for runs of any distance I enrich the mixture a trifle and keep the cock wide open, and am making 30 miles to the gallon—short runs excluded—over country roads and about half of them sandy; more than 50 per cent better than I could do before. On rough country roads and city streets the cock is kept closed; with it wide open the engine will not work well when running slow.

The gas pressure in the manifold of an engine running at fair speed is much below atmospheric pressure resulting in a suction on the carburetor intake which effects the feed. When the engine slows down that suction and the inflow of gas are decreased to the point where, when mixed with the inflowing air from the pet-cock it becomes too lean to fire properly.

The increased power I get is probably due both to better evaporation and to the expansion of the air heated in the cylinders by the burning gas, and that leads to the idea that some day air may be used in gas engines to a much larger extent than at present. The air may be admitted and compressed in the cylinders as the gas is now and the burning gas admitted at the moment of ignition from a separate chamber. And then there is dust many kinds of which under right conditions are powerful explosives, and such conditions should not be difficult to provide in gas engines.

I witnessed the results of the flour mill explosion in Minneapolis in 1878, and since have had considerable respect for the potentialities of dust.

Caldwall, Ida. H. W. STONE.

### To Einstein Prize Essayists

To the Editor of the SCIENTIFIC AMERICAN:

I have in my possession a type-written lecture of recent date given by a German scientist on Einstein's principle of relativity. The lecture is supposed to be a popular one, although it is not free from mathematical formulas. It was held before a group of technical engineers in one of Germany's largest industrial plants. I am willing to loan it to any of the competitors for the Einstein prize essay who is able to understand German, on condition, of course, that the lecture be returned to me in due time.

Bowman, N. D. CHAS. BACHER.

# Concrete and the Building Crisis

## Some of the Advantages Which Have Led to Wide Adoption of This Structural Type

By Robert G. Skerrett

STRUCTURAL concrete bids fair to be our industrial salvation in the erection of loft, office, and factory buildings. The housing situation for many of our indispensable activities has reached an acute stage, and we are likely to be hampered for some years to come unless we can provide quickly and at a reasonable cost proper accommodations for our business, our productive, and our administrative enterprises of various kinds.

Building materials of more familiar kinds are high priced and difficult to get with any dispatch, deliveries being more or less uncertain; and skilled labor of all classes is exceedingly expensive and likewise hard to obtain. Nevertheless, no one wants to put his money in a building that falls in any way short of accepted structural standards. Happily, there is a solution for the problem.

Reinforced concrete no longer involves physical uncertainties. The technique of mixing has been reduced to definite formulæ suitable to divers needs. The qualified builder knows today that he must make certain that neither his aggregates nor his sands contain injurious vegetable or other organic matter, and tests are prescribed which enable him to determine this. In the same manner he understands that he should use water that is clean and free from oil, acid, alkali, or vegetable substances. He has learned that the measure of water in the mix bears directly upon the utlimate strength of the concrete and also determines the time that must elapse before his molds may be removed. Finally, experience has taught him that his reinforcing metal should subscribe to standard specifications and be free from excessive rust, scale, paint, or coatings of any character which might tend to reduce or to destroy the bond between the steel and the enveloping concrete.

Failure to adhere to these requirements by people who have rushed into the field of concrete construction without proper training explains the disappointing results that have occurred from time to time. Today the established companies engaged in this branch of engineering go forward with the same confidence that would follow the use of other materials.

In a number of our populous centers it is essential that there be reared as quickly as possible some scores of buildings of the loft type, ranging anywhere from six to twelve stories in height, in order that the most can be made of the ground area available; and an analysis of existing conditions in the labor and material markets reveals that these demands cannot be met speedily unless concrete be employed.

An office building that brings out the artistic possibilities of concrete

This huge structure, 200x331 feet, covering an entire square, is representative of the best concrete factory design

**Two concrete buildings of different types now going up in New York**

*THE expansion of industry and the concentration of business enterprises in our centers of population have brought about a real crisis. Structural materials and skilled labor are hard to obtain in sufficient quantities to rear the buildings that are sorely needed. In this situation reinforced concrete bids fair to provide an ample and a ready relief. The reasons for this are broadly covered in the accompanying article, but emphasis is given this presentation by an analysis of costs of the structural frame for a 10-story loft building, in different types of construction:*

*All reinforced concrete, $1.50 per square foot.*

*Reinforced concrete except that steel cores are used in both exterior and interior columns, $1.90 per square foot.*

*Structural steel with terra cotta or cinder-concrete floor arches, $2.50 per square foot.*

*Contrary to the belief entertained by the uninformed, the adoption of concrete does not entail dampness, difficulty of making changes, or any uncertainty as to safety.*—THE EDITOR.

The strength of a concrete structure is largely dependent upon the disposition and the dimensions of the supporting columns. In buildings up to twelve stories in height, a suitable concrete column of circular section to do the work of a 20-inch-square steel column would have a diameter of approximately 34 inches; such a concrete column might be properly designed to carry a live load of 150 pounds. Of course, there are at times objections to surrendering so much floor space to the larger cylindrical concrete columns, but this difficulty can be offset by substituting on the lower floors smaller concrete columns strengthened by cores of either steel or cast iron. Naturally, as each added story is reached the weight to be borne diminishes, and all-concrete columns of lesser diameters answer on the upper floors. A concrete skeleton building, even when having steel or iron-cored columns, will cost considerably less than a steel structure of like proportions. The adoption of the more expensive columns would hinge, of course, upon the rental value of the floor space saved.

The thickness of concrete floors for a specified load varies according to the distance between the columns. In order to obtain the needful girder strength, the floor thickness is greatest where the span between the columns is longest; and the factor of safety commonly allowed by competent designers has proved on many occasions equal to a much greater burden. For instance, floors of the girder-beam-and-slab type, intended for a load of 200 pounds to the square foot, were found capable of holding up under an average weight of 900 pounds; and another floor of the flat slab type, for which the prescribed load was also 200 pounds, did not fail when the burden reached more than 1,200 pounds. Concrete girders having a 50-foot span are carrying right along floor loads of 500 pounds to the square foot.

The monolithic character of reinforced concrete buildings admirably adapts them to resist the vibration which might otherwise be set up by rapidly moving machinery; so mechanical equipment can be held rigidly to the floors and run at higher speeds. Factory work can thus be permitted in structures where the other tenants might be seriously disturbed if vibration existed.

In Greater New York, nearly every loft and office building has granolithic concrete floors. Those that are not so fitted have wood floors; there is no structural or economic difficulty involved in this detail, the choice being determined mainly by willingness to pay the difference in cost. For the sake of finish, some owners prefer brick curtain walls, but this often involves a sacrifice of floor space. An 8-inch concrete wall is claimed to be as tight as, if not tighter than, a 12-inch brick wall; and there is rarely any trouble with concrete walls even though they have not been waterproofed in any way.

The reinforced concrete structure of the loft type saves money inasmuch as the interior walls and ceilings need no plastering except in the entrance halls, etc., where a certain meas-

**The early appearance of the huge concrete building of an electric company in New York, showing the emplacement of column molds and the work of laying concrete and erecting forms on the ground floor**

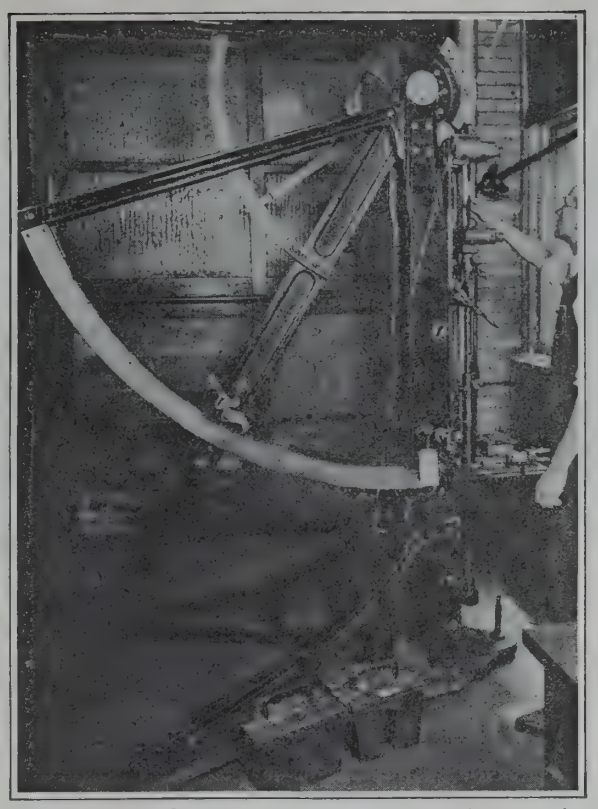
e of decoration is desirable. The adaptability of the ncrete loft structure is well brought out where it is ared adjacent to old buildings. In such circumstances is possible to place the wall columns from four to six t inside the external lines, carrying the exterior walls cantilevered floors. On narrow city lots this charac-istic might prove a highly important factor.

As time is of the essence of the present situation, the eed at which concrete buildings can be erected is of pment. On the average, from the time decision is ade to start work a concrete building can usually be npleted at least as quickly as a typical steel struc-re of the same dimensions. And carefully prepared tail estimates show in numerous cases a saving of per cent over steel where structural concrete fram-g is employed; while the total saving on the com-eted and outfitted structure often averages quite 20 r cent. All this is well illustrated by a building w going up in New York City and covering an area 331 x 200 feet.

A ground plan of such magnitude, filling in fact, a ole square, requires the movement, distribution and placement of large quantities of materials during various stages of construction. Reinforced concrete ll be used throughout with the exception of a brick neer on the exterior walls. Here we have striking dence of the benefits of mechanical equipment for handling of essential materials. To begin with, re are centrally located in the basement two power-ven mixers placed directly beneath the towers of o gravity plants for the delivery of concrete any-ere within the building area. The sand and gravel e dumped at one side of the site from the street el into a bin from which the premixed stuff is rried by a belt conveyor to the middle of the cellar d there transferred to two smaller conveyors running right angles. These drop the aggregate into bins se by and the latter feed directly into the power xers. Attached to each bin is a hopper of a scribed capacity, and the attendant worker has only raise a vertical sliding door to release the desired ount of the sand and gravel. Similarly, from the jacent platform, just enough cement and water are asured and dumped into the mixer to make up a bic yard of concrete. The mixer delivers the con-te to a hoist bucket, and every minute it is possi-to raise a load to the desired height, dump it into tower hopper, and send it by gravity down the e of chutes to any point between the base of the ver and outward within an operative radius of 160 t. In this way, the two towers can handle two bic yards every 60 seconds. No trouble is experi-ced in thus placing, during a working day, quite 700 bic yards of concrete.

The counterweight chutes, supported by steel booms, rmit the utmost flexibility. The distributing system es not clutter up the floor in any manner. There e no trestles or runways to interfere with workers gaged in other parts of the undertaking. The con-te can be delivered as fast as the mixer can pre-re it and as soon as the forms are ready to receive The equipment saves in unit labor costs because e hoisting engine and gravity take the place of the n otherwise required to wheel the concrete from the int of mixing to those of deposit. The amazing ature about up-to-date work of this sort is the many ngs of various kinds that can be done simultaneously thout causing confusion. A little analysis reveals at this would not be possible but for the mechan-l facilities employed in mixing and in distributing

(*Continued on page 409*)



The arrow at the upper right shows where the strap is inserted in the machine. Note that the one here being tested has just parted

**Measuring the strength of a leather strap**

## Testing Ropes and Straps

HOW strong are the stirrup straps used on your favorite riding horse? Are the traces used in pulling farm machinery equal to the task? And, figuratively speaking, is the rope strong enough to hang a man? Such questions can be answered by a machine perfected by the Bureau of Chemistry, United States Department of Agriculture, which is capable of testing the tensile strength of fabrics, textiles and harness leather.

For instance, if you wish to know the strength of the belt you wear on your clothes, put in motion the one-and-one-half horse-power motor in the laboratory of the Bureau, thus starting the tensile machine. Different weights are applied to the pulling lever, the apparatus operating from a pivot near the top along graduating scales, one of which automatically records the pulling power necessary to break a given piece of textile, fabric or harness leather. Our illustration shows the general ensemble of the machine, and suggests quite clearly the manner in which the leverage necessary for the test is brought to bear in increasing measure until failure occurs.

The object under test is gradually given all the load it will bear, the machine automatically registering the stretching strength of the object up to the breaking point. The apparatus is not only valuable for determining faulty textiles, fabrics and harness leather, but the data can be applied in drawing up specifications in manufacturing material of substantial tensile strength. It is said to be the largest machine of this character in use.—By *S. R. Winters.*

## Piling Up the River Bottom Into a Dike

MARK TWAIN, in one of his most amusing veins, described the disease which might be named Mississippitis. It consisted in a violent attack of emotional insanity in connection with one or another of the projects afoot for the improvement of the valley of this great stream. But the peculiar part of the thing was that it never affected any two people exactly the same. Where one maniac would range over the country in the cause of dredging a channel of ridiculous depth from the Twin Cities to the Gulf, another advocated with equal ardor the filling of the river so as to make the water scour out its own navigable pathway. Where a third enthusiast was booming the construction of vast works to prevent floods, another was distributing propaganda looking toward the expenditure of millions of dollars for large reservoirs in the upper parts of the Mississippi drainage basin to prevent the recurrence of low water.

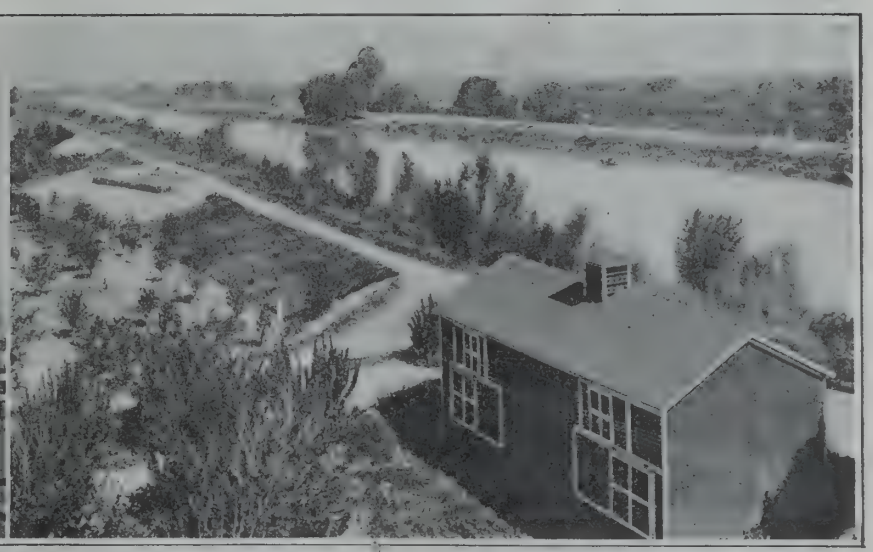
The great humorist does not tell us so explicitly, but it is a fact that he could depict such a variation of opinion as to what ought to be done to the Mississippi, merely because the problem presented by the river does actually vary most widely from season to season and from year to year. It does carry its flood levels to destructive heights, and it does go down, in its dry season, to a point that is destructive to interests that depend upon a reasonably full river. It does call for treatment of the most divergent character, and does confront the engineer with directly contradictory requirement. And while a good many of its vagaries have been successfully dealt with, some remain.

But today the Mississippi is not alone in puzzling the engineer through the apparently irreconcilable nature of the problems that it presents. California has a river—the Sacramento—that goes to equally violent extremes, and calls for equally contradictory measures in its control. And here there is an additional complication not present on the Mississippi. The State of California is interested, more than anything else, in the volume of irrigation water that it can get out of the river. But the Federal Government steps in to say that the river is a navigable stream, and must be treated and conserved as such. Accordingly the engineers must so handle the river that there shall be enough water for the irrigationists, and enough left over after they are through with the stream to float the ships which carry their products to the markets.

The whole problem really resolves itself into one of flood control. When this is properly handled, the subsidiary problems of irrigation and navigation will have been resolved. And, as our photographs show, the control of the spring flood waters is being undertaken in a rather novel way.

The problem centers in the so-called delta—a region of flats under low water, which has been built up by the deposits from the periodical floods of the centuries. The treatment consists in diking—but the distinctive feature is the manner in which this diking is carried out. It happens that the material from the bottom of the river in this section is sufficiently heavy and water-resistive to make satisfactory dikes; so the process is simply to turn a big dredge loose, piling up the bottom of the flat into a high ridge. At one stroke the waterway is deepened, and enclosed within a confining dike that protects the surrounding territory from reinundation. Our pictures show work of this sort in progress, and a scene where it has been finished, so that the greatly narrowed and deepened stream flows along with its surface well above the level of the surrounding country behind the dike.

Dredger building up a levee between river and flooded bottoms



Where the river walks on stilts, high above the fields

**The process of deepening the Sacramento River which results in banking it up in an artificial channel, well above the level of the surrounding country**

**General view of the British rigid dirigible R-80 after the successful completion of the trial flight**

# The Aerial Cruiser

## Some Details Concerning the Latest British Rigid Dirigible R-80

SOME twelve months after the notable trip of airship R-34 from England to America and back, a smaller edition of that ship, R-80, which embodies many improvements, had a successful trial flight. We present several views of this ship, and there follows a description of its construction and a comparison with the earlier and larger R-34.

At the time the ship was taken out for its first trial, the wind was blowing with a velocity of fifteen knots. The flight, which was carried out over the sea, lasted about two hours, and a landing was safely effected in a wind of about seventeen knots. Both in leaving the ground and in its return to the shed, R-80 was handled with facility and the trials were an unqualified success.

By way of comparison we give the accompanying table comparing R-80 and R-33.

### Construction

The main transverse frames are placed between the gasbag ends, with intermediate members. All the framework girders are of triangular cross section. Transverse wiring at the main frames transmits the lift of the gas to the keel girder and maintains the shape of the transverse section. A longitudinal stay connects the transverse wiring at each main frame. The main diagonal bracing wires are of three series—major, minor, and mesh wiring; the first two on the external surface of the ship. The mesh wiring on the inner surface of the girders transmits the gasbag lifting pressure to the framework. The triangular keel girder has its base formed by the lowest flat of the transverse frame polygon. This keel contains the cabin, bombs, petrol, water ballast, etc., and is sufficiently strong to transmit all loading, including the weight of the cars, into the main structure. There is a walking way the entire length of the keel girder, with branches to the wing cars, providing thoroughly sheltered communication.

The total gas space is divided into fifteen compartments, each containing one gasbag. The outer cover is formed with a number of separate panels laced to the girder, the joint space being covered with a sealing strip.

A novel feature is a walking way and hand line which run along the top of the hull. There is a g platform forward, and ventilation shafts are plac between each pair of gasbags.

### The Four Cars

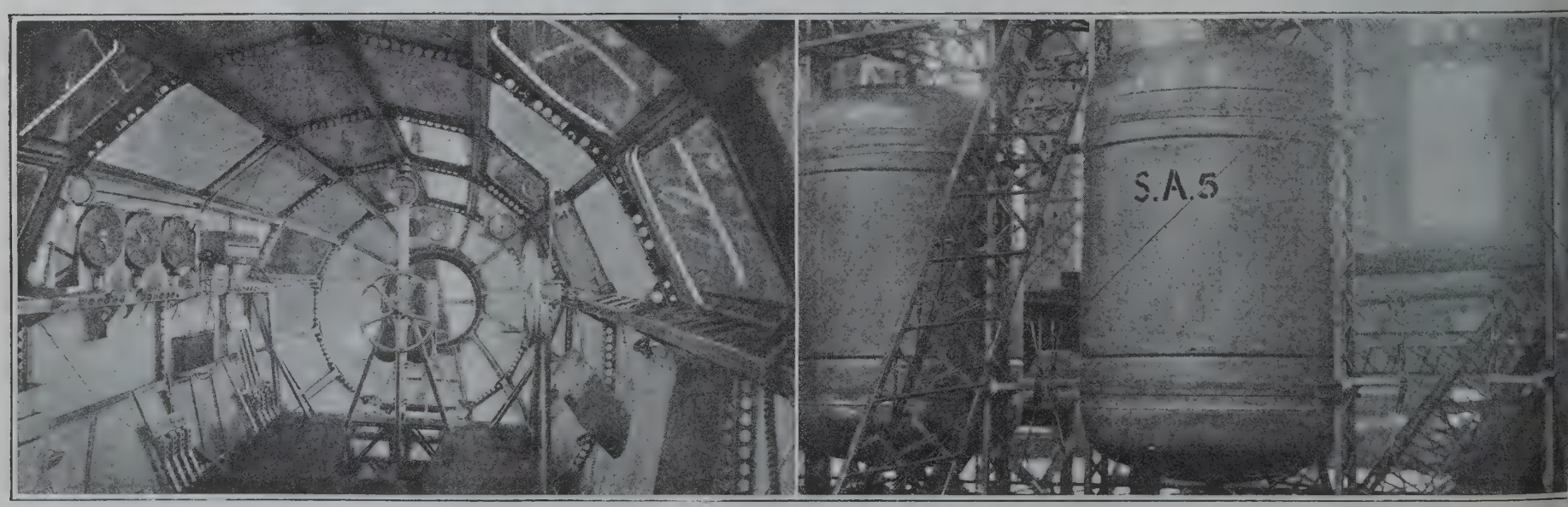
There are four cars suspended from the hull, t two forward ones being placed one behi the other and joined flexibly together form one streamline shape. The forwa half is the control portion, and in it a found the navigating controls and instr ments and the wireless cabin; in the af portion there are two sets of engines. T two separate wing cars are suspended each side of the keel and each contains o set of engines. Particular attention h been given to the elimination of head r sistance and the cars, which are built duralumin, have a perfect streamli form. Opening windows of triplex gla are fitted where required, and in po tions of less importance there are wi dows of non-inflammable celluloid.

Below every car is attached a speci inflated buffer bag; these bags have su ficient buoyancy to enable the ship alight and float safely on the water, a they also make an effective cushion wh landing on the ground. The contro from the forward car are conducted up through t trunk, which leads from the car to the ship, and th they are taken forward or aft through the interi keel. There are large luminous indicators in the co trol car, which show the degrees of helm and elevation. All the gas valves are operated from t

(*Continued on page 409*)

*The R-80 and R-33 at a Glance*

| *Particulars* | *R-80* | *R-33* |
|---|---|---|
| Gross displacement (tons) | 38.25 | 60.0 |
| Gross disposable lift (tons) | 17.80 | 26.75 |
| Minimum weight of crew, stores, and ballast required for prolonged flight (tons) | 3.8 | 5.0 |
| Residual disposable lift available for fuel and oil (tons) | 13.7 | 21.75 |
| Speed at full power, m.p.h. | 65.0 | 65.0 |
| Speed at cruising power, m.p.h. | 50.0 | 50.0 |
| Total b.h.p. at full power | 1,000 | 1,500 |
| Range in miles—full power | 3,900 | 3,600 |
| Range in miles—cruising power | 6,400 | 6,000 |
| Endurance in hours—full power | 60 | 56 |
| Maximum height attainable as free balloon (feet) | 19,500 | 18,000 |
| Maximum height attainable with crew and stores for prolonged flight | 17,000 | 16,000 |




*Left:* Looking forward to control car, showing steering gear, ship's telegraph and telephone instruments, gages and so on. *Right:* The gasoline tanks which are slung in the keel girder.

**Two views aboard the R-80, showing how the British constructors are gradually refining their airships with the appearance of every new dirigible**

## What Are Great Britain's Mystery Towers?

IN a previous issue we printed an account of the two "mystery ships" then building for the British Admiralty. Their strange appearance and the air of mystery surrounding their construction and their use aroused great comment at the time.

Constructed on a sandy foreshore at Southwick, an obscure village between Storeham and Brighton on the Channel Coast, the two "mystery ships" have long been objects of interest. In shape they are not unlike a huge wedding cake, consisting of three tiers of hollow concrete blocks, surmounted by a tall wide tower, not unlike a gas-holder. The total height of each ship is almost 200 feet. Their method of construction is highly ingenious. The bottom story, consisting, as has been said, of hollow concrete blocks, rests on the foreshore; the tides play about it, and the long months during which it has lain on the beach have covered it with seaweed and barnacles. Powerful pumps are installed in the lower tier so that it may be pumped dry at will. Sluice gates are also fitted to enable it to be flooded and sunk. Until Sunday morning, September 12th, this lower tier was full of water, the weight of this serving to ballast the whole structure which towered above.

Early in the morning, at low tide, however, the sluice gates were opened and muddy water poured from the openings of the lower tier. As the tide rose the sluices were closed and the pumps were set to work. Within a short time they had lowered the water level in the hollow concrete by a further four feet.

Meanwhile the tower had been attached by hawsers to two lighters. As the tide rose—an exceptionally high spring tide for which the engineers had waited some weeks—the tower, now lightened of its ballast, rose too. Its ungainly bulk was trimmed until it floated upright—its upper deck some 200 feet above the crowd of spectators. The "launch" was accomplished slowly and without fuss. There was no excitement of greasy slipways and quick spectacular glissade.

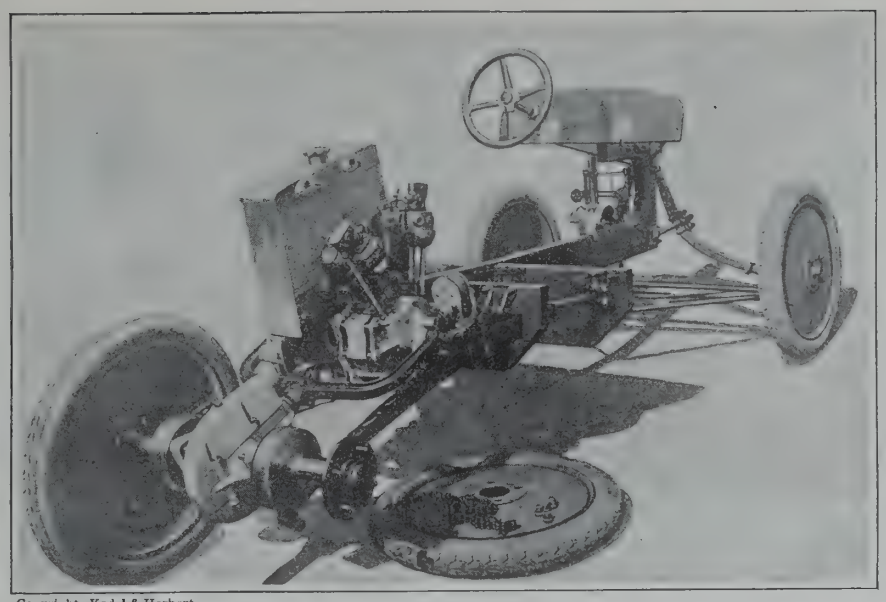
As soon as the tower had floated, a flotilla of Portsmouth Dockyard tugs stood by to tow it. The task was not easy. A specially dredged channel had been prepared; the draught of the tower is such that the clearance in some parts of the channel is measured in inches. Seven tugs were used in the towage. It was necessary to guide the huge bulk between wooden piers. Notwithstanding repeated warnings, these were lined with interested spectators, and a chance tilt against the piers would have seriously damaged both the tower and the pier, with probable loss of life.

The tricky passage was negotiated with only one unimportant mishap, and as soon as the tower was clear it was seized by additional tugs and slowly made its way by open sea (which was exceptionally calm) toward Spithead. It is thought that its destination is the Solent, but official quarters are reticent on this point.

Its companion tower is scarcely completed and conditions will not be suitable for its "launch" until the high tides of March next.

The whole of the arrangements for the building and launch of the tower have been under the charge of Capt Cliffe of the Royal Marine Engineers.

Speculation is still rife concerning the probable use of these mystery towers. One of the many theories advanced is that they will be used for raising the shipping sunk during the war by the German submarine campaign. By means of these towers, it is suggested, sunken vessels lying in water too deep or too rough for ordinary salvage could be raised. By "dragging," hawsers might be passed underneath the sunken vessel. The towers would be sunk, one on either side, and the hawsers made fast. The two towers (which may be submerged to a depth of 180 feet) would be simultaneously pumped empty of water, thus raising the vessel. The whole flotilla, with the vessel cradled between the two towers, coulb then be towed away to shallow water, where the vessel could be beached. By repeating this process it would be possible to salve vessels now lying far too deep for recovery. Such is the theory.



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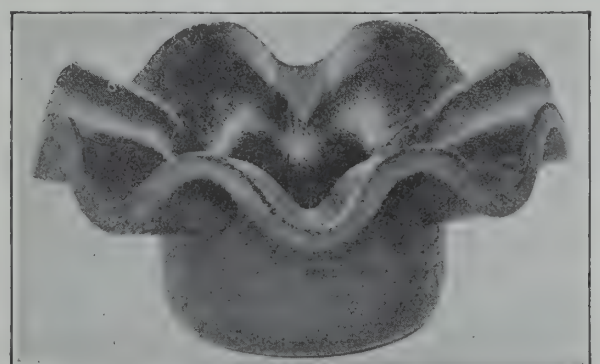
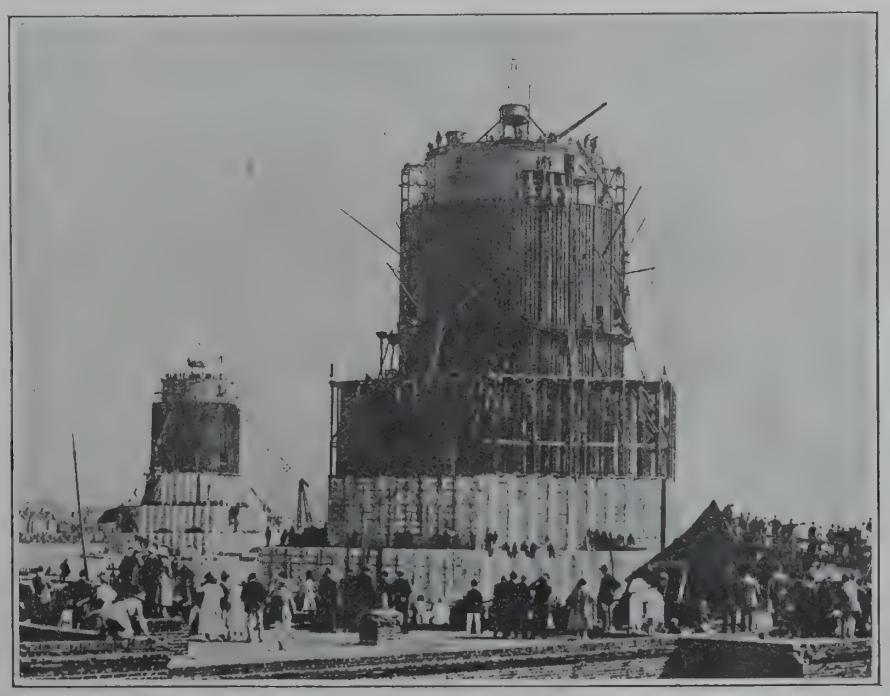
**This novel departure from standard practice represents a French effort at producing an inexpensive automobile**

Another suggestion is that had not the armistice intervened in November, 1918, some five or six of these towers would have been sunk in the Straits of Dover, made tight on the seabed with concrete grouted in, and pumped clear of water. The gigantic caissons so formed would have enabled work on the Channel Tunnel to be carried out with great rapidity. By sinking shafts in the interior of each tower, and driving headers in each direction from its foot, a dozen working faces would have been secured; whereas if the tunnel were to be driven from each end in the usual way, two only would be available.

Further suggestions are that the towers are destined to serve as protective underwater fortresses for the Naval Harbor at Portsmout—a contention which gains ground when it is remembered that the first tower has been towed to the Spithead.—By *F. Rawlinson.*



**This queer-shaped cup was recently moulded from a piece of leather over four hundred years old**



**What are they? The British authorities are satisfied to have them called "Mystery Towers," but will say nothing regarding their purpose**

## Reducing the Automobile to Its Essentials

FROM France comes the latest idea in automobile designs, namely, the frameless car. Indeed, here is a design which calls for an automobile that is practically all power and wheels, so to speak, with the usual parasitic elements reduced to the irreducible minimum.

A study of the accompanying view of one of the new cars tells the entire story. It will be noted that the usual frame construction is done away with, and in its stead we have little more than springs. The engine, which is a two-cylinder affair, is placed at the rear, so that this chassis is obviously intended for a two-passenger car. The radiator is placed sideways, as shown. The rear axle, it will be noted, is mounted on a pair of springs and held by a U-shaped member whose legs terminate in pivots on either side of the power plant, the latter being mounted on the center of the springs. All in all, this construction is exceedingly novel and ingenious, although it seems quite obvious that it can only be applied to the lightest kind of passenger cars. But for these it will surely economize fuel!

## There is Nothing Like Leather

THE leather cup which we illustrate is a striking proof of the durability of good leather, for it is at least four hundred years old. Proof of its age is found in the following facts. At some time prior to 1893 there was standing in the city of Hamburg, Germany, an old building which had to be removed to make way for improvements. Records and tradition established the fact that this building had been standing four hundred years. There is nothing very remarkable about that; but when the building had been torn down and the foundations for the new building were being dug, the workmen discovered some old tan vats, which were evidenty the remains of an old tannery that had been in operation on this site before this four-hundred-year-old building was put up. In one of the vats, which probably had been filled in with earth, they found a relic of the old tannery in the shape of a tanned hide. Part of this hide fell into the hands of a prominent merchant in Hamburg, who dealt in leather goods. He was sufficiently interested in the relic to have molded from a piece of the hide a leather cup, which he brought with him to America in 1893, at the time of the Chicago Exposition, and he left this cup with one of the largest of our leather manufacturers, who vouch for the integrity and standing of Mr. Gearckens, the donor of the cup. In consideration of its great age, it is a tribute to the quality of this ancient piece of leather that it could be molded into such a shape as this. We are informed that only a very high-class piece of leather would stand, without breaking, the pressure required to complete the right-angled bend at the bottom of the cup, as shown in the illustration. The forming of the fluting at the top of the cup was a strain upon the leather only a little less severe. Yet the leather has been bent and molded both in these convolutions and in the body of the cup itself without showing any cracks.

The *Bulletin* of the National Association of Leather Belting Manufacturers, in speaking of this interesting experiment, reminds us that the enduring life of good leather is due to the fact that it does not corrode or oxidize or disintegrate, and as this piece proves, will retain its life for centuries.

## Paper on a Specification Basis

RECENTLY a marked increase in the use of paper bags as containers for lime and cement was noted. Uncle Sam in his paper conservation campaign is investigating the various materials suitable for such purposes. He has devised an invaluable test machine which shows definitely the stress, strain value of the paper as well as the stretch which results under load. He now is perfecting a testing apparatus which will reproduce under laboratory conditions the strain on the bag when it is dropped. The idea of the government experts is to so correlate these tests that the actual service conditions to which bags are exposed may be reproduced in the testing laboratory.

# Items In Brief

*A Department Devoted to Current News in All Fields of Pure and Applied Science*

## *Electrical*

**X-Rays and the Shoe.**—A leading New York store has recently installed an ingenious X-ray outfit which permits its patrons to see just how their feet fit in any pair of shoes. In fact, at a glance the patrons can note the position of the bones of their feet in any given pair of shoes, and in that manner determine whether they are trying the proper last or not.

**Radio Control for Airplanes.**—There can be no doubt that if the war had lasted a few months longer we would have witnessed the leading armies employing great fleets of airplanes controlled by radio means. The United State Army had progressed pretty far along this line when the armistice was declared. The same can be said for Germany. Now we learn that the French have demonstrated that five or six small and inexpensive bombing planes, without pilot, can be successfully guided by a "shepherd" in a larger plane through the means of Hertzian waves.

**Glass Insulators for High Voltages.**—Tests with glass insulators have been in progress in Switzerland for several years, and numbers of these insulators have been used in France and the United States, for potentials up to 50,000 volts. The principal application for glass insulators is, however, up to 25,000 volts. Such failures as have occurred with glass insulators have been due principally to internal stresses which cause cracking when the insulator is subjected to heavy mechanical stress or sudden temperature change. The occurrence of such failures has been made less frequent by the use of improved material and better annealing. As for the puncture strength, it is higher than that of glazed hard porcelain. The glass used in Switzerland is clear and transparent, hence the absorption of solar heat is less than in the dark green glass hitherto employed.

**High-Power Arc Lamp.**—In the Garbarini rotating arc lamp the inventor aims at (1) a single light-source of small area and great brightness; (2) the integral utilization of the light from a source; and (3) the automatic maintenance of the point-source in its correct optical position. A horizontal, cored positive electrode is used forming a small central crater. The negative is of metal, cooled by circulating water or gasoline, and is non-luminous. It is annular in shape, and terminated by a ring-edge; the crater of the positive is situated at the center of the annulus. The arc formed between the annulus-edge and the unobstructed positive crater would tend to wander and become unstable. Accordingly a solenoid is mounted with the positive electrode as axis, and the magnetic field thus produced causes the arc to revolve at 500 to 3,000 r.p.m. At this speed the motion is not detected by the eye, which merely sees the central bright spot, the crater, surrounded by a slightly luminous haze. Such an arc has, in effect, uniform length and resistance and gives a constant light.

**New Tank for Transformers.**—A leading electric company is developing the use of a so-called conservator in connection with oil-filled transformers. The conservator consists of an auxiliary tank connected to the top of the main transformer tank by a suitable pipe and mounted above the level of the oil in the main transformer tank. The main tank and the connecting pipe are completely filled with oil, and the only oil that comes in contact with the air is that in the conservator. The size of the conservator is governed by the thermal expansion and contraction of the oil. The oil must not contract sufficiently to allow air to enter the main transformer tank, and when hot the oil must not overflow. In practice suitable oil gages, oil valves, chloride of lime chambers, and sump are provided in the conservator. The elimination of the air space in the main tank is of importance because this removes the chance of an explosive mixture of gas and air above the oil. Any gas that forms escapes into the auxiliary conservator tank, where there is no possibility of ignition.

## *Communication*

**Another Clandestine Wireless.**—The steamer "Eten," which was the German steamship "Rajah Kootis," may have played a more important rôle in the war than merely that of housing a number of interned German sailors in a Peruvian port. Indeed, upon examination at an American port it was discovered that a water cooler in a stateroom of this steamer contained a wireless set. The obvious conclusion is that the interned crew may have communicated with German sea raiders at various times.

**Safeguarding Radio for Emergencies.**—The United States authorities who watch out for the welfare of wireless on land and sea, report that operators have been using their auxiliary source of power (storage battery) for the operation of audions. The auxiliary source of power must not be used for any purpose other than that of operating the transmitter in the event of accident, when the usual ship's current supply fails. The battery must be kept fully charged and ready for immediate use. Any defects in the battery or any other part of the radio equipment should be reported to the master of the vessel immediately. Such neglect of duty on the part of operators may be considered sufficient cause for the suspension or revocation of their license.

**Light Telephony.**—It is quite obvious that the Germans, too, were working along the lines of telegraphy and telephony by means of light rays during the late war. In a recent issue of a German periodical there appears a description of an apparatus for effecting telephonic communication along a light beam. The receiving apparatus consists essentially of a conical tube with a plano-convex lens at the wider end and a special selenium cell at the lens focus. The cell is included in a special valve amplifying arrangement to which are connected telephones. The transmitter consists of an arc searchlight, and the microphone current is superposed on the arc current by inductive coupling. The radius of such an arrangement is limited to three or four miles for small apparatus.

**What Is It?**—From Denmark comes a brief—all too brief!—report of the work of one Rahbeck, the inventor of something new in the field of communication. In company with one Johnson, Rahbek has been working for six years on the new invention. They discovered a new force resembling electro-magnetism in 1917, and eight days later they evolved the type of loud-speaking telephone of which the violin string appears to be the essential part. Next the inventors constructed a pocket electroscope far more sensitive and more easily handled, so they claim, than all previous instruments. One use of this new force which they have put to work would be to increase the receiving capacity of wireless stations. The inventors are now working on a device which will permit of despatches being received twenty times more quickly than now. All of which is interesting, to be sure; but what is it all about?

**Recording Sounds with Light Rays.**—In connection with the several light ray methods of communication developed during the war, it is interesting to note the latest means of recording and reproducing sounds by means of light. A. O. Rankine, writing in the *Proceedings* of the Physical Society, tells us that the light from a photophone transmitter is concentrated on a narrow slit, an image of which is produced by means of an auxiliary lens on a strip of motion picture film, the slit image being transverse to the film. The variations in intensity of the light when sound waves are received by the instrument are recorded as variations in the density of the film after development. For reproduction of the sounds, light from an illuminated slit is focused on the film, behind which a selenium cell, connected to a telephone circuit, is placed. As the film moves, the intensity of the light reaching the cell varies in accordance with the density of the film, and the corresponding sound is heard in the telephone.

**British Cable Delays.**—Considerable delays are reported by the Postmaster General in the handling of telegrams from Great Britain to the Continent. Of late the average delay on messages sent to the Continent was about 4½ hours, with a maximum delay of 22¼ hours recorded. By way of comparison, the delays experienced during the same period in the case of other services were also noted. The average delay on messages to North America via the Imperial Cable is reported to have been 3¾ hours, with a maximum delay of 10 hours. The services to the Near and Far East were subject to an average delay of about 10½ hours, with a maximum delay of about 24 hours. Recently the British Post Office instituted an "urgent" telegraphic service to Paris, at three times the ordinary rate, in view of the practice of many business men in London sending cables for Paris via New York. It is reported that a specific test was made recently to determine the advantages of the new "urgent" service to Paris. The message which went by way of New York was delivered in Paris 20 minutes before the one sent by the "urgent" direct cable.

## *Industrial Progress*

**Baedeker Again.**—It is reported that the famous series of guide books known as Baedeker's, is again on sale in Germany. The first two volumes to come out are "Brandenburg" and "Saxony," thus indicating that Germany now is no longer to be regarded as one united state. Under the old régime there were four Baedekers of Germany. However, the thoroughness and accuracy of the text and maps alike remain at the pre-war standard of excellence.

**A Guide to Latin America.**—The need for a guide for commercial travelers to Latin America has just been met by a publication entitled "Commercial Traveler's Guide to Latin America," issued by the Bureau of Foreign and Domestic Commerce. For the convenience of the reader the book has been divided into two sections. The first part deals with general matters such as salesmen's equipment, transportation, suggestions for procedure upon arrival at destination, etc. Maps of Latin America accompany the guide.

**Better Rubber or Cheaper Rubber?**—A recent demonstration in India of a new process for the vulcanization of rubber took place at the Manchester College of Technology, it is announced in an issue of *Commerce*. Vulcanization of crude rubber mixed with a large proportion of waste material like leather shavings or sawdust was proved by this method to be chemically possible, as well as a saving in time and cost compared with existing methods. It is claimed that this process will produce a material which will stand the test of wear and weather.

**Our Standing in Shipping.**—According to Lloyd's Register of Shipping for 1920-21 just issued, the seagoing tonnage of the United States shipping has increased since 1914 by over 500 per cent. American tonnage now stands at 16,049,000 tons, which places the United States second only to the United Kingdom, which has 18,330,000 tons. Japan is now third, with 2,963,000 tons, followed by France with 2,963,000 tons. Including sailing ships, but excluding tonnage on the Great Lakes, the United States now owns 24 per cent of the world's tonnage as against 4.7 per cent six years ago.

**Consumption Estimates, 1919,** an annual publication of the Bureau of Foreign and Domestic Commerce, is now available. It presents condensed statistical tables showing production, imports, exports, and amounts available for consumption of various articles in the United States. Cotton, wheat, corn, sugar, wool, coal, pig iron, iron and steel rails, pulp wood, and tobacco are among the important trade items which receive individual attention. Copies are on sale at the Government Printing Office, Washington, D. C., and at the district and coöperative offices of the Bureau of Foreign and Domestic Commerce. The price is 5 cents.

**Milk from Peanuts.**—The common peanut is the source of a new substitute for milk which so closely resembles its prototype that it turns sour and curdles, produces butter milk when churned and may be made into cheese. The flavor, in which the nut characteristically persists, is declared to be practically its only point of variance with cow's milk. The new lacteal product originated in the laboratory of an American university where the peanut kernels are converted into four times their volume of milk, varying from 4 to 8 per cent in fat content and from 2.4 to 3.3 per cent in protein. The cost of production is said to be considerably less than the market price of dairy milk.

**Is Europe Going Back to Bartering?**—Trade with Germany on the part of Holland direct or on the part of other countries through Holland is becoming more and more difficult as a result of the exchange situation in Germany. The fluctuations of the value of the mark are great and violent, and the impracticability of forecasting the variations to even an approximate degree has made it almost impossible for German buyers

safely to import even the most necessary goods. Bartering has developed as one way out of the difficulty and is being practised to an increasing extent. For example, a deal was consummated recently for the sale of 1,000 tons of American flour to German importers for an equal value at current prices of coal-tar pitch.

## *Power and Fuels*

**Cotton Rope for Power Transmission.**—The superiority of cotton rope over manila is emphasized in a recent issue of the *Journal* of the Engineering Institute of Canada. Though the initial cost of the cotton rope is the greater, its superior resilience, grip, groove impact and prolonged life—five times that of manila—quite outweigh the disadvantage in first cost. Cotton ropes evaporate acquired moisture quicker than manila and are less susceptible to internal mildew.

**Steam Pipe Losses.**—The German Association of Steam Users has issued a pamphlet calling the special attention of its members to heat radiation losses from the surfaces of steam pipes and boilers. It is pointed out that such losses with steam at a pressure of 170 pounds per square inch and a temperature of 374 deg. F. amount to 924 B.t.u. per square foot per hour and represent substantial sums owing to the high cost of fuel. The expenditure incurred in providing good non-conducting material is not serious and is repaid in two months by reduction in the coal bill. The radiation from flanges is practically the same as from the corresponding area of pipe, and it is recommended that an efficient type of flange cover should always be adopted.

**Tidal Power.**—The power available from tides at a given station is analyzed and graphical methods are given for determining the level in the tidal basin to give a maximum value for the mean power, in a recent issue of the *Genie Civil.* Since turbines only run in one direction, they should be placed between two parallel channels, one for the inflow during the rising tide, and the other for the outflow during an ebb. Since the fall is variable turbines should be operated in series when the fall is considerable, and in parallel when the fall is small. At peculiar states of the tides there are dead periods when no power is developed. This becomes less troublesome if, instead of a single station, a series of stations is erected along the coast. The dead periods will not fall at the same instant at the different stations. It is recommended that the installation should combine tidal, up-stream water reservoirs and thermal plants. The latter of course are to be used as auxiliaries when the water power falls below the requirement.

**Wood Charcoal and Its Manufacture.**—The uses to which wood charcoal is put are numerous, chief among which may be mentioned its use as a source of cheap power for running gas suction engines, for smelting purposes, and for smithy work. It is also used as a smokeless fuel and in the manufacture of ammunition. On account of its porous nature and the very large internal surface it contains, charcoal has the power of absorbing large amounts of gases. Similarly, charcoal, especially bone charcoal, prepared by heating bones, will absorb coloring matters from solutions, so that it finds a considerable application as a decolorizing and deodorizing agent. It is utilized also for insulating purposes, as it is a bad conductor of heat and electricity, and is given to poultry in crushed form. The chief constituents of wood are cellulose and lignin, both rich in the element carbon, and when wood is burned in the presence of air, light, heat and gases are produced, while ashes containing the mineral constituents of the wood form the residue. When heated to high temperatures without free admission of air most of its organic substances (cellulose, lignin, etc.) are decomposed and given off as gases, a residue of impure carbon remaining. This impure carbon residuum is called charcoal, and it consists almost entirely of the the element carbon mixed with a certain amount of still undecomposed carbon compounds and the inorganic constituents of the wood chiefly in the form of potassium carbonate.

## *Engineering*

**Making Good the Roubaix Canal.**—Certain sections of the Roubaix canal were demolished by the Germans in their retreat in 1918, and it is the repair of these sections that *La Technique Moderne* recently described. The work carried out included the excavation of the canal bed, and the locks, work of checking the still apparently sound portions, remaking of damaged and destroyed portions, provision and erection of lock-gates, substitution of new parts for the temporary parts supplied and erected provisionally by the Allied Armies, construction of bridges to replace those destroyed, and other subsidiary works. The work was carried out very rapidly on the most modern lines, concrete being used largely in place of rubble and other materials. In the Roubaix section of the canal the whole of the ruins have been excavated, the canal bed dredged over a distance of 20 km.; 13 locks have been replaced, and 49 road bridges, viaducts, and foot-bridges re-erected over the canal.

**T.N.T. as a Blasting Explosive.**—The U. S. A. being left with millions of pounds of surplus T.N.T. on the conclusion of the war, the problem has arisen how best to utilize it in industry. Experiments made by the Bureau of Public Roads demonstrate that T.N.T. can be used with reasonable safety, but is not so economical as dynamite. It can be made more effective and also cheaper by admixture with sodium nitrate, ammonium nitrate, or other cheap oxidizing agent which will consume the excess combustible matter in T.N.T. It may also be desirable to add waterproofing material. Moisture and temperature do not materially affect the work of T.N.T., nor does it appear to affect the health of the user in open-air work. The amount of T.N.T. required for such work is about 75 per cent of the necessary charge of 20 per cent ammonia dynamite, continues the *Road-maker, Excavator and Grader.* On account of the smaller quantities used, definite sizes of cartridges should be made, since there may be considerable danger from overloads if the material is not properly cartridged.

**Upward Pressure of Dams.**—Experiments are described, which aimed at adding to the meager fund of information available regarding the upward pressures existing under masonry dams and other similar structures on porous foundation, in a recent issue of *Engineering News-Record.* The determinations were made at the Island Park Dam, Dayton, Ohio, and the apparatus employed was very simple. An unexpected discovery was that methane gas was accumulating in considerable quantities beneath the dam, and it was found that this gas had the effect of increasing the upward pressure, or the tendency of the dam to float. From the experiments it seems evident that although sheet-piling and cut-off walls are of value in reducing upward pressures, their effect is not necessarily in accordance with the line of creep theory. The results obtained are probably not representative of conditions existing immediately after the closure of the dam, and it is therefore concluded that the greatest danger exists when the head against such a structure is first accumulated. The upward pressure may soon be reduced to an unimportant factor, the length of time required to bring about the change being dependent upon the rapidity with which silt is deposited over the bottom. The formation of gas under the dam is a potential source of danger, if the shape of the structure is such as to confine the gas.

## *Pure Science*

**Radiotelegraphic Research at Woolwich.** — According to *Nature* many important investigations in radiotelegraphy are under way at the experimental establishment of the British Army, at Woolwich. Speeds of transmission of from 450 to 1,000 words per minute are attained by an adaptation of the Wheatstone automatic transmitter. Special attention has been given to the linking up of line with wireless systems. High-speed messages, coming in over the wire in the ordinary way, are automatically transferred to the radiotelegraphic apparatus without loss of time in retransmission. The British Army is much interested in direction-finding apparatus, and very compact sets for this purpose, with a range up to 250 miles, are being standardized at Woolwich.

**A New Journal of Physical Abstracts.**—For more than three-quarters of a century the chief repository of physical abstracts for the world at large has been the *Fortschritte der Physik,* which, in recent times, has comprised three volumes a year. In order to ensure a more rapid dissemination of abstracts of current literature in physics, the Deutsche Physikalische Gesellschaft has discontinued the publication of the *Fortschritte* and a new semi-monthly journal, similar in contents, called *Physikalische Berichte,* has been started by the above-named society in conjunction with the Deutsche Gesellschaft für technische Physik. This publication will also supersede the *Halbomonatliches Literaturverzeichnis der Fortschritte der Physik* and the *Beiblätter zu den Annalen der Physik.* Dr. Karl Scheel, who edited the *Fortschritte,* is editor of the new journal, which is published by Vieweg & Sohn, Braunschweig.

**Foodstuffs Fumigated with Cyanide Gas.** — The Public Health Service has investigated the possibility of the adsorption or absorption and retention of cyanide gas by foodstuffs during the process of fumigating vessels, warehouses, etc., with resulting danger to the consumer. The foods selected for the test were fresh bread, which, on account of its spongy structure, offers excellent conditions for the adsorption of the gas, and milk, because it is the most available liquid food. The bread and milk were exposed to cyanide gas under a bell jar for periods varying from 2 to 22 hours, and subsequently fed to white mice. If given to the mice immediately after exposure to strong fumes of cyanide, poisoning resulted, probably from the fumes temporarily retained by the food. When the food was exposed to the air for an hour or two, it was harmless to the mice. The conclusion is that the possibility of poisoning occurring from food materials exposed to cyanide gas under ordinary conditions is extremely remote.

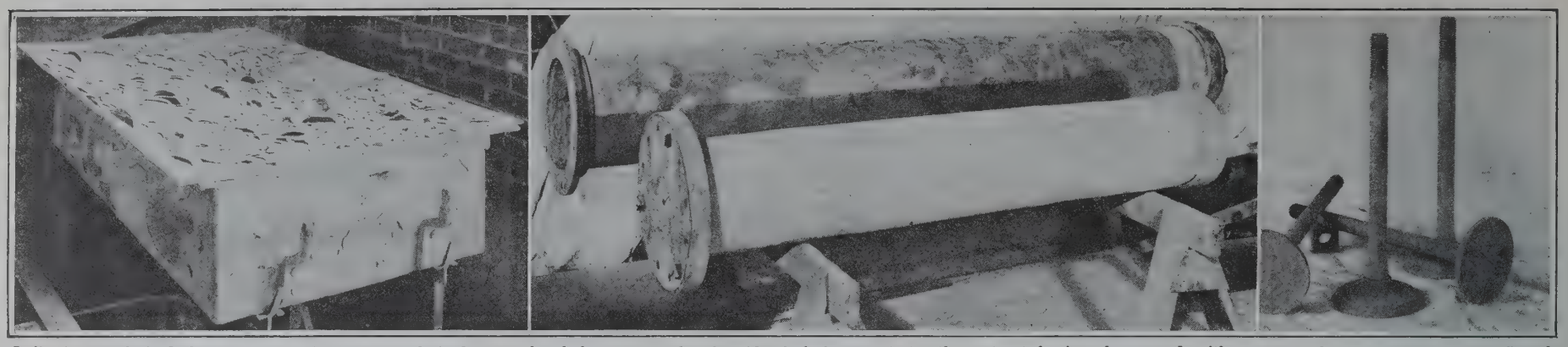
**Motion Pictures of Weather Maps.**—The U. S. Weather Bureau has been investigating the plan of making motion pictures of weather maps, as already carried out, in a tentative way, in Europe. Prof. J. Warren Smith, who has this matter in hand, reports that scenarios have been outlined to show: (1) The movement of a West Indian hurricane from the Atlantic into and across the Gulf of Mexico and thence across the eastern United States to the Gulf of St. Lawrence; (2) the movement of cold waves; (3) heavy rainfall and floods; (4) heavy snowstorms; (5) local thunderstorms and tornadoes; and (6) comparisons of the climate of different areas. The movements of storms and weather conditions will be shown by weather maps drawn for every 15 minutes, and each map will be photographed from 6 to 48 times. The maps will be accompanied by motion pictures showing the actual weather and its effects, including storm damage, waves on the coast, snow scenes, orchard heating to protect against frost, etc.

## *Automotive Progress*

**Change Oil in Crankcase to Prevent Wear.**—A recent test showed that to prevent excessive engine wearing crankcase oil should be changed at least every 1,500 miles, preferably every 1,000 miles. A new engine that was run 6,000 miles with oil changed at proper intervals, upon being disassembled showed no signs of wear. The same engine, reassembled and run 6,000 miles with old oil plus new oil as needed, upon inspection showed a wear of 0.015 inches. Motor truck and passenger car manufacturers recommend, for better performance and longer life, that crankcases be drained every thousand miles, the engine flushed with kerosene and new oil added.

**Growth of Motor Express Lines.**—Motorized highway transportation is growing with astonishing rapidity. New York State alone has over four hundred motor express lines in operation. It is estimated that, for the whole country, there are not less than 5,000 such lines in operation. These lines are of greatly varying size and widely scattered. The American Motor Freight Company, with headquarters at Sioux Falls, South Dakota, is incorporated at $500,000. A map of its route includes 80 towns in Minnesota, Iowa and South Dakota. The New England Transportation Co., which operates out of Boston, is reported as having 150 motor trucks in service which operate over 12 routes totaling over 1,000 miles in length. The Patriot Motor Express Company, of Wichita and Kansas City, Kansas, is capitalized at $1,000,000. It is operating throughout Kansas, Nebraska and Missouri and will use 150 motor trucks.

**Chicago Limits Truck Weight.** — Amendments to the traffic ordinance in Chicago have been drafted to be submitted to the city council with a view to preventing rapid destruction of the street pavements by excessively heavy traffic. The proposed changes were discussed at a recent meeting in the office of the city engineer, Mr. Coombs, who is chairman of the special traffic commission charged with drafting the amendments. It is proposed to change the gross weight of vehicle and load from 40,000 pounds, as at present allowed, to 30,000 pounds, with a maximum weight of 1,000 pounds per inch width of tire, but it was agreed at the meeting that the combination of a motor truck and semi-trailer with load should be allowed a weight of 32,000 pounds, with a limit of 24,000 pounds on any one axle. During the meeting the city engineer said he was very much in favor of the use of trailers and felt it was preferable to have loads spread over the six or eight wheels of motor truck and trailer or semi-trailer rather than to have the weight concentrated on the four wheels of the machine carrying the load alone.



*Left:* An uncalorized sheet of iron and a smaller calorized rectangle of the same stock, after identical furnace tests—the untreated piece is covered with severe scale, the other is not affected. *Center:* Calorized (front) and uncalorized (rear) retorts after equal service. *Right:* Diesel-engine valves, a fair sample of the sort of thing that may profitably be calorized

**Several exhibits designed to show the immunity to rusting under severe heat conferred by the new process of "calorizing"**

# Preventing Rust at High Temperatures

## Aluminum-Coated Metals That Will Go to the Melting Point Without Formation of Scale

By Robert June

THE problem of devising means of protecting metals from oxidation at high temperatures has occupied the attention of metallurgical engineers for many years. The remarkable industrial developments of the past few years, particularly with respect to heat treating processes, have made this problem of pressing importance; and it has consequently received greatly increased consideration.

To say at the outset that this problem has largely been solved by the development of what is known as a calorizing process is to sum up the experiences and opinions of many metallurgists and industrial engineers who have encountered serious and at times seemingly unsurmountable difficulties in the rapid oxidation of metal parts at high temperatures.

In the calorizing process, the metal chosen is aluminum, and the protective action is due to the oxide formed by the action of heat on the protecting alloy rather than to any electrolytic relations between the aluminum and the base. The product is distinguished from that of other processes such as sherardizing, hot galvanizing, etc., in that these are intended primarily to give protection against oxidation at ordinary temperatures, or corrosion, as it is frequently called, while the calorizing process is intended primarily to protect against oxidation at high temperatures.

Practically all metals suitable for structural work, with the exception of those in the platinum group, began to oxidize at quite low temperatures; on the Centigrade scale, steel at about 370 degrees, copper at 360, nickel at 660, nickel-steel (58 per cent nickel) at 530, chrome-nickel (10 per cent chromium) at 650, German silver at 530, and aluminum-bronze (9.2 per cent aluminum) at 600. As a matter of fact most of these metals or alloys may be run at a higher temperature than that indicated before serious disintegration sets in, but none of them has a very short life at or above a full red heat.

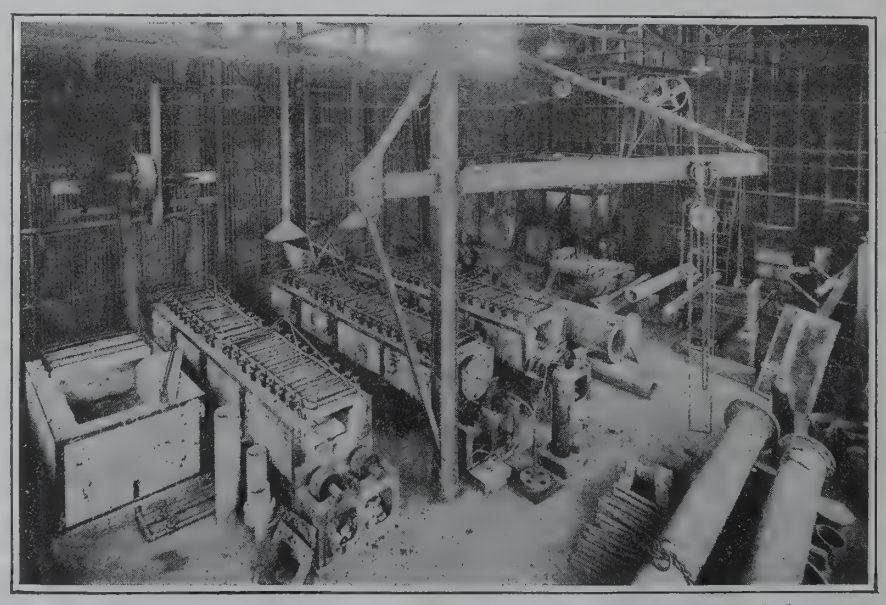
It is well known that an aluminum wire heated by an electric current above its melting point will still maintain its shape due to the tough and resistant oxide of aluminum formed on its surface. It is this oxide which is the basis of the oxidation-resisting properties of calorized metal. It is necessary, however, to have sufficient aluminum present to form a continuous coating of $Al_2O_3$ over the whole surface. Experiment has shown that this requires, in the case of iron alloys, at least 14 per cent of aluminum.

The calorizing process was developed about 1911 in the electrical research laboratory at Schenectady, in the course of a series of experiments instituted to find a method of protecting electric heating elements. The process was later turned over to an independent corporation, as its industrial and commercial importance warranted its handling by a separate organization specializing in oxidation problems.

In treating metals by the calorizing process, they are first thoroughly cleaned by sand-blasting, then placed in a stationary or rotary retort in a reducing atmosphere, with a mixture composed of finely divided aluminum and aluminum oxide. This treatment, conducted at a temperature of 600 to 1,100 degrees Centigrade, depending upon the depth of alloy desired, so thoroughly infuses aluminum into the exposed portion of the metal being treated as to form a homogeneous aluminum alloy for a certain depth. This depth ranges from a few thousandths of an inch to the permeation of the entire mass, varying with the duration of the treatment.

The essential point in difference between the effects of calorizing and most of the processes hitherto used commercially, such as galvanizing, plating or coating, is that the protective metal is not imposed as coating or skin upon the metal to be treated, but rather enters into intimate association with it, forming a "solid solution" alloy. For this reason, should the outer surface become slightly injured, the protective surface renews itself. Calorizing is not intended to protect against rusting or corrosion, as is sherardizing for example, but is primarily a protection against burning or scaling. Calorized copper, brass and nickel, however, are also excellent non-corrosive elements and are strongly resistant to the acid. The dimensions and weight of the metal treated are very slightly increased by calorizing. The increase in dimensions is usually not over a few thousandths of an inch.

An example of its commercial application is in the manufacture of soot blowers, which as applied to boilers must be exposed continuously to furnace gases at high temperatures, and are not cooled by water or steam as are boiler tubes. Ordinary iron or steel will not give successful service. Under these conditions, one of the early means employed in protecting this equipment against burning out consisted of two extra heavy steel pipes, placed one within the other, the space between being filled with insulating material of special composition. This type of installation was fairly successful, but involved an excessive first cost; therefore, manufacturers of soot blowers were constantly on the lookout for material from which these units could be economically made, and which would give even more satisfactory results. Very soon after the calorizing process was announced, a comprehensive investigation of it was made in this application.



**Retorts and furnaces in which the calorizing process is carried on**

In addition to mechanical tests, trial installations were made in all the different types of water-tube boilers. In making tests, calorized soot-blower units were placed in the hottest passes where the temperatures ranged from 1,800 to 2,500 degrees Fahrenheit. The need of blowers at these locations had long been recognized, but their application had been considered impracticable. Performance of the calorized units was watched with keen interest for months. In the end they proved that they fully met the hardest service conditions. There were no signs of scaling or disintegration from the long exposure to high temperatures. Thousands of successful installations have been made, and are now giving satisfaction in all types of water tube boilers. In addition to the matter of oxidation, many gases contain sulfur dioxide and carbon monoxide, which have an extremely deleterious effect on ordinary metal, while tests have shown that calorized metal is not affected by them in the percentages in which they occur in furnace gases.

The resistance of calorized iron to oxidation is a time-temperature function. It will resist oxidation up to its melting point for a short time, but to obtain a reasonable life, temperatures exceeding 900 to 1,000 degrees Centigrade should not be used unless the calorinzing treatment was unusually heavy. The reason for this is evident when we consider that the diffusion of the aluminum into the iron is extremely rapid at high temperatures. It is about five times as fast at 1,300 as at 110 degrees Centigrade, which would cut the life to one-fifth when used at the higher temperature. By using thin sections and a heavy coating, however, steel may be calorized to stand the higher temperature for months.

Although tests show that the mechanical properties of the steel are not injured by calorizing, it must be pointed out that the rich aluminum alloy which forms the protective coatings is very hard; any bending or mechanical working should be done as far as possible before calorizing. If it must be done afterwards, the piece should be first heated to redness. Calorized metal cannot be hammered or bent cold, but at a bright red heat can be bent without affecting its resistance to oxidation. However, calorized metal is capable of withstanding all ordinary handling without destruction of the alloy or calorized portion.

Calorizing has been put to a great variety of uses including its application to retorts, carbonizing and annealing boxes, pyrometer tubes, furnace castings, tubes for preheating air, flue lining, pipe for conveying molten glass, torch nozzles, blast furnace tuyeres, oil crackers, soot-blower units, lead pots, valve and piston heads for Diesel engines, preheating coils for oil burners, hot bulbs for oil engines, etc. Calorization has been successfully applied to carbonizing and annealing boxes and a variety of heat treating equipment of this nature, the treatment prolonging the life from three to thirty times.

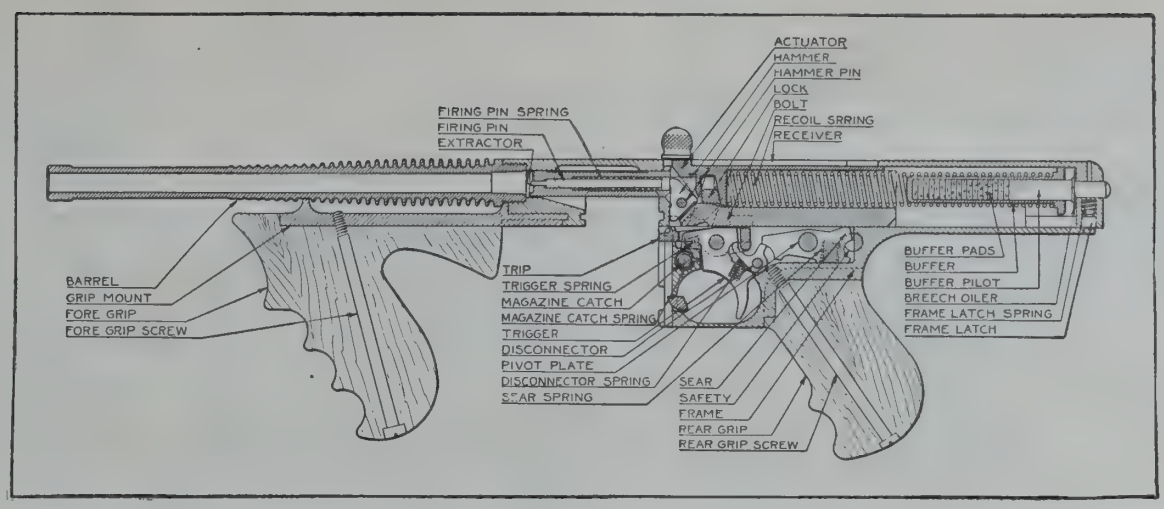
It is entirely feasible to make up calorized coils of pipe in a wide variety of

(*Continued on page 412*)

## A Pocket Machine Gun

By Capt. E. C. Crossman, U. S. A.

THE marksmanship of the average policeman with the average policeman's revolver is something to make honest men turn pale, and the women and children duck for the subway. Here and there are exceptions, but as a general rule policemen seem far inferior to yeggs when it comes to hitting things they intend hitting with the pocket gun. I do not know whether the yegg spends some portion of his ill-gotten gains in target practice or whether his ability to hit, where the officer misses, is due merely to the cussedness of inanimate nature. The fact remains. Wherefore the announcement in the public prints of the adoption by the New York police of the wicked little Submachine Gun is of course interesting to those persons who wish to see the customary New York brand of gunplay made a little less one-sided.




**Cross-section of the pocket machine gun, showing its components and the general assembly**

Without doubt the early future will see a happy coincidence of a policeman skilled in the pointing of the new weapon, and an automobile full of yeggs willing to engage in the customary running gun flight. The result will be the worst-shot-up assortment of crooks that has come to the attention of the coroner.

The new gun as adopted by New York consists of a 7-lb. weapon, 22 inches over all, and capable of being carried in concealment. It is sort of a compromise between a pistol and a rifle, with the speed of fire of the highest speed aircraft machine guns. It is turned out by a new and strong organization headed by the former Assistant Chief of Ordnance of the Army, the officer who gave to the Army the M 1917 rifle during the war.

As designed for American use it is chambered for the caliber .45 automatic pistol cartridge, with its powerful and knock-down blow inflicted by the 230-grain bullet. The barrel is less than a foot long. A grip for the left hand lies below the center of the barrel, while another for the right hand lies near the rear end of the gun, below the breech casing. The magazine is between the two grips.

So arranged, the gun is intended to be fired from the waist line, the fire being directed by the sense of feel, as one throws a stone, and as used in the "marching fire" of attacking infantry during the war. The arm is truly automatic, not the semi-automatic self-loading type so often miscalled automatic. Such arms require a pull of the trigger for each shot, the mechanism merely ejecting and reloading the gun. The Submachine Gun is a true machine gun in that it fires as long as the trigger is held back and the cartridge supply kept up. This particular arm, however, has a theoretical speed of fire of 1,500 shots per minute, higher than any other weapon on earth, and three times as high as the average of machine guns used for land use among various armies.

If the trigger is held back, the result is a verberating roar of shots coming so fast that the ear cannot distinguish them apart. This of course empties a twenty shot magazine in less than a second; but the fire is easily controlled by the trigger pressure, and I found no trouble in firing single shots merely by a quick pressure of the trigger and instant release. Any number of shots between the single shot, and the entire capacity of the magazine is thus at the disposal of the firer.

Were the gun designed for a military cartridge and of this weight and proportions, it would of course be absolutely unmanageable in automatic fire. Those who have used the 16-lb. Light Browning automatic rifle can testify to the difficulty of keeping the gun from whirling the firer around and twisting the gun toward the sky. The recoil of the .45 pistol cartridge, however, is very light, and the writer, accustomed to handling the Light Browning rifle, found it easier to control the fire of the Submachine Gun than the Browning automatic rifle. The gun is fed by magazines of varying capacity from the flat, box-type, 20-shot affair, to the drum-shaped carrying 50 or 100. A feature of the arm is its absolute simplicity and fewness of parts. When resolved into its components for cleaning one can discover only fourteen or fifteen parts, and the gun is taken down without a tool and in a few seconds.

The arm is novel in that its designers arranged it to be oiled—as they say like any other gas engine, which is of course the correct classification of the automatic rifle or machine gun. Felt pads lying within the receiver walls and so out of the way of dust and grip, are impregnated with oil, which the bolt picks up in its reciprocating motion. The advisability of oil in a machine gun for military use is open to question, but the certainty of function of this little gun, and its terrific rate of fire evidently owe much to the oiling of the parts and lead to thought as to whether or not this is not desirable with any other weapon of this high speed, heating and hitherto rather unreliable type. Nothing more elaborate is required in this oiling than a squirt of an oil can into the pads every 500 shots or so, nor will the gun cease to function if it is not oiled.

The writer, as fire control officer of the Small Arms Ballistic Station at Miami and Daytona, Fla., conducted by the Ordnance Department of the Army, was

*(Continued on page 413)*

1—New York policemen using the new pocket machine gun which fires .45-caliber automatic pistol cartridges at the theoretical rate of 1500 shots per minute—higher than that of any machine gun. 2—The pocket machine gun fitted with the 20-shot box-type magazine, and gun butt. 3—The pocket machine gun fitted with the drum-shaped magazine carrying 50 or 100 rounds.

**Two types of pocket machine gun magazines and how the gun is used by the New York Police Department**

# What Science Did for Cheese

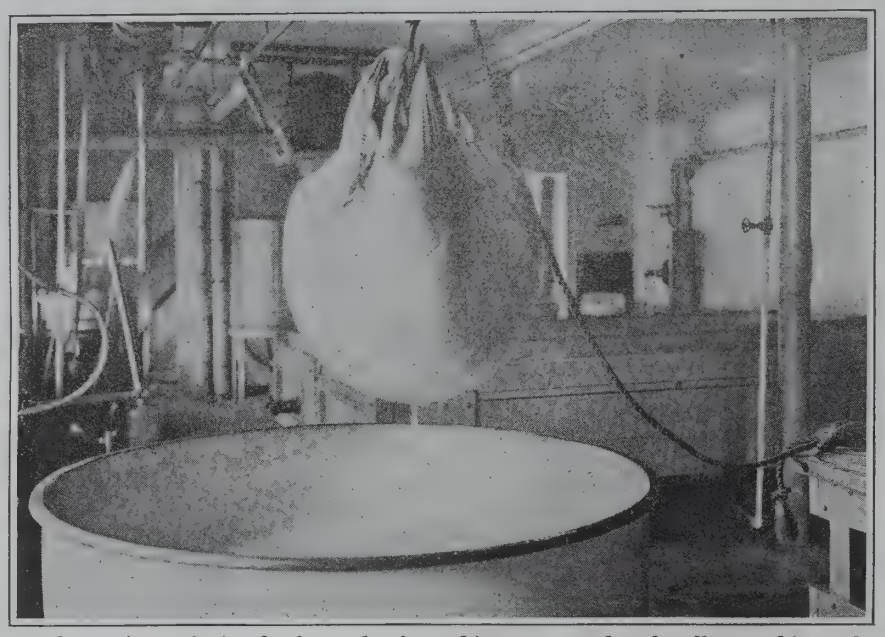
## How Precision Was Substituted for Guesswork in the Making of Swiss and Other Varieties

By George H. Dacy

ONE of the most recent scientific discoveries of the National Department of Agriculture has eliminated the gamble from Swiss cheese manufacture and has made it possible for American cheesemakers to produce better cheese than the best which ever emanated from Emmental, Switzerland, the Alpine native heath of dairy delicacies of this description. The art of Swiss cheese making—for it was an art which was handed down from generation to generation of hardy Switzers—was never dependable; the maker—no matter how experienced and skilful—was always liable to run into snags in the way of unfavorable climatic conditions or other environments which proved prohibitive to the rapid multiplication and activities of the organisms which framed the holes in the cheese and imparted to it the sweet, nutty flavor characteristic of the best imported Swiss cheeses.

We American consumers as a class were not familiar with these inside facts of the manufacturing complexities, because none but the best Swiss cheese was ever exported from Switzerland. However the prices which we had to pay for these imported food-products were accurate reflections of the trouble and losses involved overseas in their manufacture. Under the rule-of-thumb methods which previously have been typical of Swiss cheese production, ordinarily only from 40 to 50 per cent of each batch of cheese that was made was high grade while the balance was of inferior quality, selling for low prices. More than five centuries of experience in cheese manufacture were fruitless so far as the standardization was concerned and assurance that a certain proportion of high quality material would obtain from the operations of the maker supplied with plenty of milk and allied conditions necessary for Swiss cheese production.

In 1845 twenty-seven families of Swiss migrated to Green County, Wisconsin, with the intention of establishing the Swiss cheese industry in the United States. Natural conditions were as favorable as they were in Switzerland for the development of dairying in the Badger State. However, the same impediment which had proved insurmountable abroad obstructed the rapid rise and expansion of the business in America—the inability of the makers to standardize the processes of manufacture and to guarantee a definite and dependable output. Appreciating that the Swiss cheese industry presented profitable opportunities and afforded a remunerative market for milk if permanently established in this country, specialists of the National Department of Agriculture some years ago essayed the task of solving the perplexing conundrum.



**Potcheese is made in the home by just this process—but hardly on this scale. The housewife would be puzzled by a draining bag that must be handled with a half-inch rope**

*NUMEROUS jests have been cracked about the holes in Swiss cheese, and the man whose job it is supposed to be to make them. But when the experts of the Department of Agriculture tried to get at the bottom of this business, they discovered that even the cheese-makers of Switzerland knew nothing about it, their methods merely working because they worked. It required, in fact, twelve years of investigation and experiment before the particular "bug" that is responsible for the holes and the distinctive flavor of the Swiss product was isolated and put on his good behavior. This and several related stories Mr. Dahl tells in this account of what the Government scientists have done for the American cheese industry.*—THE EDITOR.

These experts spent much time with the Swiss cheesemakers in America, striving to gain insight into the riddle from carefully studying the various operations. The cheesemakers themselves knew absolutely nothing about the scientific principles involved. They did such and such a thing merely because their fathers and grandfathers had done likewise. Completely baffled in their attempts to wheedle illuminative information from the domestic producers and unable to reduce the knotty problem to a brass-tack basis by their laboratory experiments, the experts finally went to Emmental, where they investigated intensively and left no stone unturned in their untiring efforts to crack the tough-coated nut. However no one in Switzerland knew the "why" and "where" of the various operations which they performed in making Swiss cheese so that ultimately Uncle Sam's scientists had to return to this country without a solution for the question, "What causes the holes in Swiss cheese?"

Bewildered but yet undefeated, the agricultural experts resumed laboratory investigations with the full appreciation that if the problem were ever to be solved it would have to be cleared up through scientific experimentation. They extracted all the bacteria—of which there were 1,000 and more—from a fine sample of imported Swiss cheese. By an elimination process, they subsequently tested out each individual bug, in turn, despite that it took twelve years to complete this highly technical exploration. The results were not promising until finally the experts decided that a change of media for the development of the bacteria was necessary. The solution of the conundrum hinged on the use of the new culture medium. Shortly the scientists isolated the particular organism which formed the holes in Swiss cheese and thereafter they revamped the entire method of production to a strictly chemical and technical basis, with the consequence that, at present, it is possible to guarantee that at least 90 per cent of the cheese crop which is made according to the new methods will be of excellent quality, adapted to suit the requirements of the most critical trade.

Heretofore, we have consumed about 20,000,000 pounds of imported Swiss cheese annually while our domestic output according to the old methods of manufacture had almost reached a similar production

(*Continued on page 414*)

The novel design of this stirring tool is an essential feature

Swiss cheese sojourning in the curing room

**Stages in the manufacture of Swiss cheese, according to the scientific methods worked out by the Department of Agriculture**

Weighing less than 200 pounds, this two-passenger car runs 75 miles on a gallon of fuel

## Speaking of Automobiles—Here Is a New One

A NEW little car, being developed by a Chicago concern, is intended to attract resort trade and the tourist. It will fit in a trunk, if the trunk is large enough; of completely knock-down construction, on a buckboard chassis with motor-wheel behind, with room for two full grown people and a weight of but 200 pounds, it will catch the trade of those who need some rapid means of transportation to get over the country. On a gallon of gasoline it will run from 75 to 80 miles. By loosening screws and bolts in a very few minutes it can be turned into a roadster or small touring car. Complete control is from the steering wheel.

## Eliminating the Troublesome Motion-Picture Bug

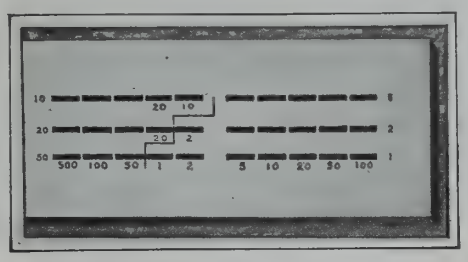
THERE is the motion-picture "bug" who is forever trying to worm his or her way into film productions. There are tens of thousands of such "bugs," and they are familiar to all of us. But this story has to do with another species of bug whose number runs into the millions, yet whose activities are more or less unknown to the general public. This species of motion-picture bug is the moth which flies around the powerful lamps of the indoor studio, and which has heretofore been responsible for many thousands of feet of wasted film.

It has remained for F. S. Mills and Clyde Ewing, motion picture men of Hollywood, Cal., to invent a machine that does away with the troublesome motion-picture bug—the winged variety, of course. This machine, which is shown in the two accompanying illustrations, consists of a wide box, a carbon arc, two incandescent lamps of 2,000 candle-power total, a funnel, a powerful suction fan driven by an electric motor, and a large box-shaped net. The operation of this device is simple. The bugs are attracted by the lights and on flying toward them they must pass over the arc. The intense heat burns them while the suction fan draws their remains into the box-shaped net. In a recent test the machine netted nearly ten pounds of bugs in less than that many minutes. By number the total haul was estimated in excess of 12,000 bugs. The lights of the apparatus are turned on during the rehearsals, so that all the bugs in the immediate vicinity are harvested, so to speak, leaving the air free until the banks of arc lamps or mercury-vapor tubes are flashed on for the actual filming work.

Two views of the "bug-catcher" now being employed to free motion-picture studios of troublesome moths

## Handling Paper Money by Push Buttons

WORKING on the problem of handling paper money by machinery, Frederick C. Weber of New York City has evolved a machine which appears to be as practical as it is ingenious. This machine consists of a cabinet divided into suitable compartments for holding the paper money, and topped with a




Typical panel used with paper-handling machine, showing the arrangement of slots

panel containing slots and push buttons. The paper money is wrapped in paper bands which feed out through the slots. The paper bands are divided off into envelopes which, due to the perforations separating one from the other, can be immediately torn off, thus forming a separate envelope with the money enclosed.

The machine contains a large number of envelope bands, as they might be called, containing various denominations and amounts of paper money. As will be noted by the keyboard depicted in one of the accompanying illustrations, the money is wrapped up so that any amount can be obtained by pushing the proper button. Thus by pushing a certain button the envelope comes through the slot in the lower-right hand corner, containing 100 one-dollar bills. The next slot to the left contains packages of 50 one-dollar bills. The next, 20 one-dollar bills, and so on. The arrangement of this panel is optional, of course, and can be designed so as best to suit any particular requirements.

The paper money, wrapped up in individual envelopes which form part of a long paper belt, is handled in advance by the average office help. Away from the rush and turmoil of the cashier's desk, this work can be carefully done and duly checked to avoid errors. The paper belts are placed in the machine at the beginning of the day's business. As for the handling of these belts, this function is taken care of by an electric motor driving an arrangement of rollers, which feed out one envelope at a time, which can be torn off; indeed, the action is similar to that of the automatic ticket machines now used in many motion-picture theaters.

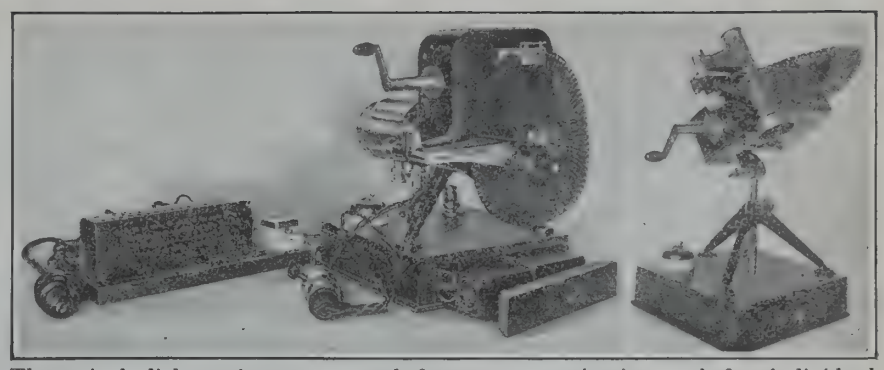
The new paper-handling machine can be used in conjunction with the usual coin-handling machine. It does away with the long waiting line of customers. It relieves the nerve strain of accurate counting of money, and enables the teller to wait on two or three times as many customers as at present. It furnishes an automatic record of all money paid out and the cash balance of every denomination on hand. It is claimed to be proof against daylight holdups; it is sanitary.

This machine handles paper money with as much facility as the usual coin-handling equipment

## Home Motion Pictures in Disk Form

IT has remained for Charles Urban, a pioneer worker in the field of motion pictures and the inventor of one of the most successful processes of natural-color motion pictures, to introduce a simple motion-picture apparatus for home and kindred use. By replacing the usual film with flexible disks, this inventor has simplified and reduced the cost of motion pictures to a point where they are available in almost every home.

The basis of the present system is a transparent disk on which the images are arranged in a continuous spiral. It has been found impractical to utilize a disk negative for photographing the subjects, hence the process makes use of standard positive motion-picture film which is projected in greatly reduced form on to the master disk. Once this master disk, which is a negative, is obtained, it is possible to print any number of positive disks for use in the projector. This reduction process requires most precise handling, and it was only after many years of constant development that the present successful results were obtained.



The spiral disk projector as used for screen projection and for individual viewing of pictures

The projector, which is shown in the first of the accompanying illustrations, embodies the usual elements. It has an incandescent lamp, condenser, shutter, lens and an intermittent gear. The operation starts with the first image on the outer turn and follows the spiral to the innermost image. Obviously, the pictures do not have to be rewound, as with standard film.

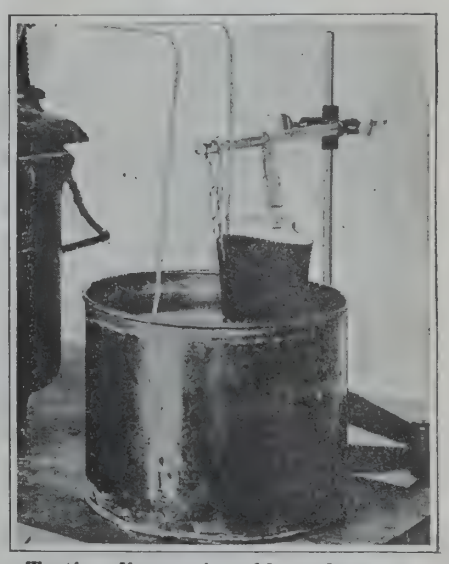
The actual size of the images is 7/32 by 5/32 inch. The 10½-inch disk contains 1,200 pictures, or the equivalent of 75 feet of film, exclusive of titles. Only two frames are devoted to titles, since the machine can readily be stopped when a title is reached, and then started up again, thus saving a great number of frames. In this manner the record may be said to equal the usual 100-foot run of film with titles. This matter of being able to stop the pictures at any point also aids in studying any given bit of action—something which is generally impossible with machines utilizing regular film.

By removing the lamp and substituting a small mirror as shown in the second illustration, the projector can be used by an individual for viewing a picture without going to the trouble of putting up a screen, darkening a room and making the necessary electric connections.

## Safety for the Linemen

ELECTRICAL linemen follow a vocation which is precarious even when surrounded by utmost safeguards, high-powered circuits involving extreme precaution by the workmen lest injury or even death result from immediate contact with electrically-charged wires. Obviously, the rubber gloves worn by linemen for handling high-voltage circuits should be able to withstand severe usage, frequent tests determining this factor. Such is the object of an apparatus designed by the U. S. Bureau of Standards, the device revealing the

(*Continued on page 415*)



Testing linemen's rubber gloves to preclude their breaking down under actual working conditions

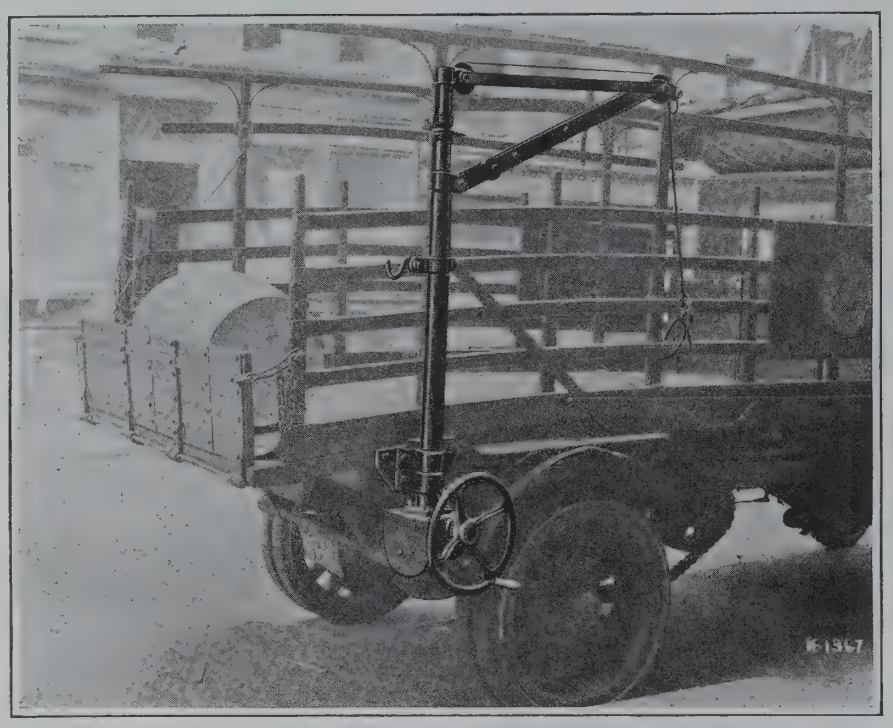
# The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

*This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles*

## Simple Hoist for Trucks

THE problem of loading trucks with heavy objects is not an easy one to solve in a large city because it is not always possible to back a truck up to a curb and use skids on which heavy objects such as boxes, barrels or pieces of machinery can be raised from the street to the truck platform. A simple elevating crane which is shown in the accompanying photograph has been devised by a New York manufacturing concern to facilitate handling heavy objects. It is composed of heavy iron pipe which comprise the pillar and arms made of bar iron. The pillar is supported by clamp members and the portion carrying the iron arm may be swung to the rear of the truck and when the load has been elevated to platform height it may be moved over the truck bed and the load deposited thereon. The hoisting cable runs down through the center of the hollow pillar to a gear-actuated winding drum carried in the base casting. A large hand wheel with handle extension from the rim is provided so the winding drum may be operated by one man without great exertion. It will be evident that this simple fitting may be used to good advantage on any truck having a rack-side body and used for general transfer purposes. By its aid one man may easily load large boxes and barrels that would be a severe tax on the strength of several men if loaded in the usual manner.

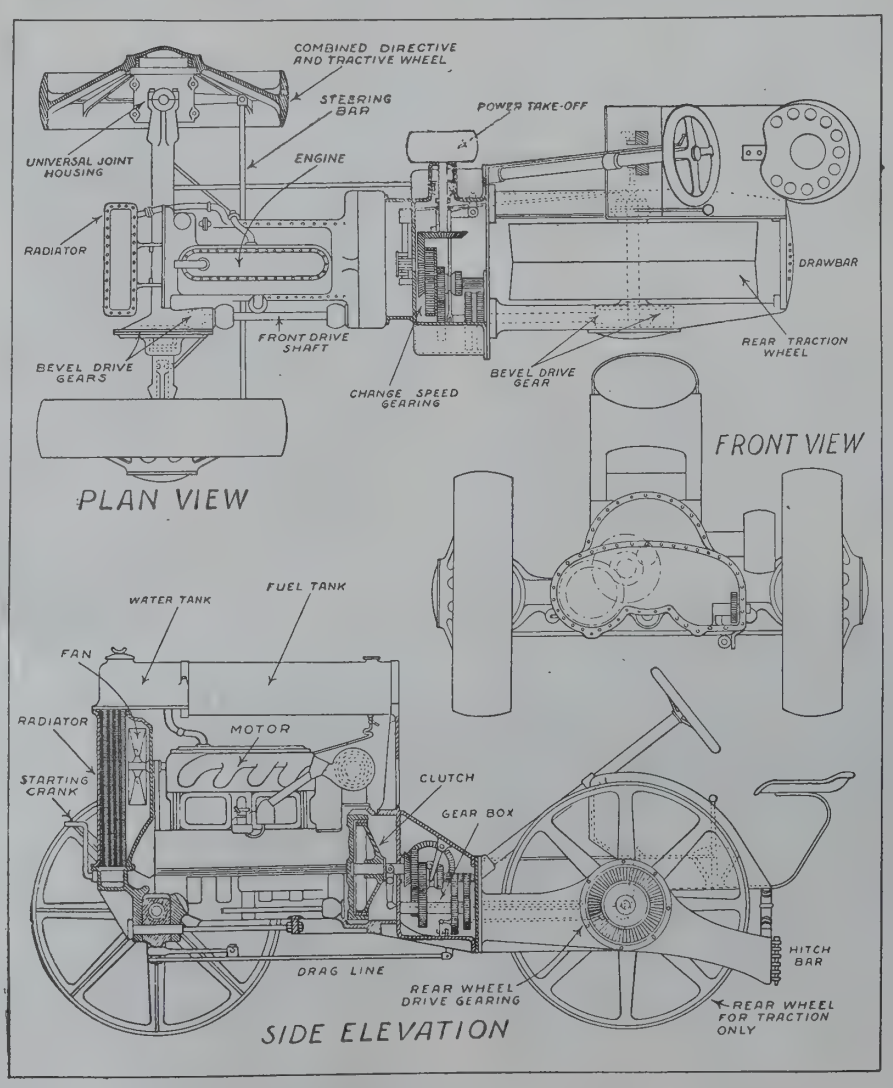


**This simple crane permits of swinging heavy loads on and off truck**

## New English Tractor

THE accompanying illustration shows a novel design of a three-wheel tractor for agricultural and road building use that has been devised by an English manufacturing company. In some respects the tractor follows late American practice inasmuch as it is the form that has no frame other than that provided by the engine base, gear box and extensions attached to the latter member to which the rear wheel is secured. Among the novel features of this tractor other than the adoption of the frameless system of design is the provision of power transmission mechanism to all three wheels. The two front wheels are combined directive and tractive members. The steering knuckles are exceptionally large and house in the universal joints by which the wheels are driven. The main drive from the change-speed gear case is by means of a double universally jointed shaft extending from the front end of the gear case to a differential housing on the front axle in which the main drive is by bevel gear reduction. The single rear wheel is operated by a shaft which carries a bevel pinion that engages the bevel gear on the wheel-supporting axle.

A power take-off is provided by which bevel gears transmit the power from the clutch shaft to a pulley at the side of the gear case to which a belt attachment can be made for driving any forms of machinery that would ordinarily be operated by belt power. The application of power to all three wheels of a light tractor is an attempt to secure maximum traction and the machine should have a greater effective draw-bar pull than any three-wheeled form of the same weight delivering the power only of one driving wheel, as is the usual construction when the three-wheel design is followed. The tractor illustrated shows clearly the influence of American practice; and the method of dispensing with the frame by using the engine base for that purpose, the incorporation of a clutch and change-speed gearing as a unit with the engine and also as part of the frame structure, and the support of the fuel tank and installation of the radiator, are all very evidently copied from a well-known American tractor design that was produced in large quantities during the war in both this country and in England. The tractor illustrated is distinctive in design, however, in the method of power transmission. The general features are so clearly brought out in the illustration that further description seems to be unnecessary.




**Details of a new three-wheeled tractor of English design**

## Motor-Truck Life

THE life of motor trucks has formed the subject of many articles. While most of the articles have been radiant with optimism, they were unfortified by fact for the very simple and sufficient reason that the fact was not available. Lately, the records of economy, efficiency and durability have been accumulating rapidly with the increasing care given to watching truck performance and it is now possible to substantiate many of the assertions of former years.

It is not an uncommon thing to read of the remarkable records of some quite old and certainly well worked machines. Those who used to argue for a scheme of depreciation based on an estimated useful life of 100,000 miles and who won little beyond scorn or good-natured toleration for their pains, now enjoy the satisfaction of seeing the proof presented in convincing form and volume One manufacturer has repeatedly drawn attention to the fact that numerous machines of his make have reached that mileage, while many others have exceeded it, some being still in service after more than 300,000 miles of economical travel. On an estimated average daily mileage of 50, which is very common in many lines of trade, this means, in the maximum case cited, a time-life of twenty 300-day years, or at least ten years, were the daily mileage as high as 100. Even a life of but 200,000 miles indicates a time-life of 13 years and 4 months at the rate of 50 miles a day. In such a case depreciation, considered as an annual rather than as a mileage charge, is no greater than 7.5 per centum instead of the 33 1/3, 25 and 20 per centum figures so frequently employed by operators.

## Mobile Shoe-Repair Shop

TWO special trucks built by a well-known Detroit manufacturer and especially equipped for the United States army as mobile shoe-repair shops, recently passed through New York on a test trip from Boston to Washington, D. C. The purpose was to show how easily such an outfit can be moved from place to place, what speed can be maintained and how it will stand up under a 500-mile road test. The first truck carries all the necessary machinery for remaking and repairing shoes, which is driven by a separate motor connected with the driving shaft of the standard stitching machine, the nailer, the scouring and finishing wheels. This motor also furnishes electric lights through a dynamo, and heating facilities are provided through registers connected with the exhaust.

The second truck is equipped as a supply depot, and carries all the materials for repairing soldier's shoes, such as sole leather, heel lifts, hob nails, tacks, welting and other necessary findings as well as extra machine parts for both the trucks and machinery. This supply truck can also be used to dispatch repaired shoes to various points along the lines where troops are located. Army officials estimate that approximately 800 pairs of shoes a day can be tapped when the mobile outfit is running with a day and night crew of seven men. There is also carried a complete set of apparatus to pull the trucks out of snow drifts or mud, consisting of ground anchor, winches, ropes, chains, picks, and shovels.

### Concrete and the Building Crisis

(*Continued from page 399*)

the concrete. From the ground level up, in the building we are describing, the same forms answer for each successive floor.

Generally, these forms are constructed of wood and have the surfaces contiguous to the concrete oiled so that they will strip readily and smoothly. The molds for the columns, however, are of sheet steel and composed of a number of segments held in place by suitable rings or straps. By omitting one or more of these segments it is practicable to use the same molds in casting the smaller columns for the upper floors. The actual progress being made in building this structure is a floor per week.

In some undertakings, buildings are reared by using sliding forms for the monolithic concrete walls, the forms moving upward as the material sets. This method of construction permits of continuous operation throughout twenty-four hours daily. Necessarily there is economy in form outlay. Reinforced concrete has been successfully employed in fashioning concrete roof girders having a span of fully 80 feet. Because a reinforced concrete building is fireproof, it is possible to obtain very low insurance rates, and this is an item not to be overlooked nowadays. Finally, it should be recalled that concreting in cold weather is entirely practicable, and work can be carried on satisfactorily the year through if certain precautions be taken to shelter the newly laid concrete from frost and to heat the sand, pebbles or broken stone, and water before mixing. And cement grows stronger with age—differing in this particular from a good many other structural materials.

### The Aerial Cruiser

(*Continued from page 400*)

control car and there is telegraph communication to all the other cars. The motive power consists of four engines, two in the machinery section of the forward car, and one in each wing car. Each engine develops a maximum of 230 brake horse-power at 1,400 revolutions per minute. The engines are six-in-line vertical, with overhead valves (two inlet and three exhaust per cylinder).

#### Supply Systems

The petrol is stored mainly in the keel corridor in 92-gallon vertical tanks. There are 34 tanks giving a total capacity of 3,128 gallons weighing about ten tons. Seventeen tanks may be readily slipped overboard to act as ballast.

#### Water Ballast

The water ballast is in two sections, one for emergency, the other for maneuvering. The emergency ballast bags discharge their whole contents when operated. The maneuvering bags may be liberated in any proportion at will. The weight of the emergency water is 2,000 pounds forward and 2,000 pounds aft. The four maneuvering bags have a capacity of 2,200 pounds each.

#### Armament

R-80 has been designed to carry the following armament:

- 8 230-pound bombs, stowed horizontally in the keel, and released electrically from the control car.
- 1 automatic quick-firing 2-pounder, and 1-cluster of two Lewis guns mounted on the top gun platform, forward.
- 2 Lewis guns in the tail gun position.
- 2 Lewis guns, one on each beam, in the forward control car, and
- 1 Lewis gun mounted in each wing car.

#### Accommodation

Separate quarters are provided in the keel for officers and men who are not on watch. The cabins have tables, chairs,

(*Continued on page 412*)


Wherever there's metal to be cut in the quickest possible time, and with the minimum waste of material, Starrett Hack Saws are on the job.

There's a Starrett Blade to suit any kind, size or shape of material. The Starrett Hack Saw Chart points out just which blade to use and how to use it. Choose the right blade, put it to work in the right way, and let it prove that Starrett Blades "cut quicker and last longer."

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### The Measure of Hack Saw Efficiency

Efficiency in the case of Hack Saws is measured both by the length of service and by the speed with which they cut. No purchaser, except one using an enormous number of blades, would ever dream of having his saws made to order, and so for practically all cases, the manufacturer determines what the saw shall be. He has the experience, the knowledge and the equipment which makes possible the manufacture of saws in the quality and quantity that are necessary to meet the many and diverse needs of industry. But his service to the purchaser is not complete unless he makes it possible for the latter to select instantly the particular saw best suited to the work in hand. Experience has proved that this may be most satisfactorily accomplished through the medium of a Hack Saw Chart based, not upon the characteristics of the saws, but upon the different materials which have to be cut in ordinary work, thus enabling the machinist to select always the proper blade by looking, not for the number of a blade, but for the name of the material he has to cut and employing the blade indicated under that heading on the chart.

As materials differ in texture of fibre, hardness and shape, so must the saws vary if we are to attain economy in the cutting-off department. When the right combination of saw and material has been made, the burden of responsibility rests upon the operator. It is his task to see that the greatest output is secured for the least cost for saws, labor, and overhead.

Economy is more than a mere reduction of first costs. As a matter of fact, consideration of first cost only usually results in inefficiency and an increased ultimate cost.—from *Hack Saws and Their Use*, published by The L. S. Starrett Co., Athol, Mass., for free distribution.

# Wire Rope—The Reclaimer

A watery, unhealthful, vermin infested swamp today, the richest farm land a year from today—the result of vision, enterprise, hard work, and the use of hundreds of feet of sturdy, dependable wire rope.

Miles upon miles of the most productive farm land owe their reclamation to wire rope. Operating on dredges and scrapers under most adverse conditions, wet, sandy, dirt incrusted, still they carry on, making it possible to produce valuable crops where disease and crocodiles bred before.

No task seems too great for wire rope—and none too unusual; for the scope of its usefulness broadens every day. But wire rope that is suitable for one purpose is not necessarily suitable for another. Each use makes certain demands upon a rope that must be met in a certain definite way.

The Broderick & Bascom Rope Co. makes wire ropes of different grades and characteristics suitable for all purposes. Each, in its proper place, will give the most service for the least money.

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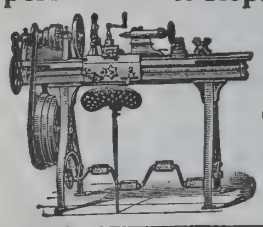

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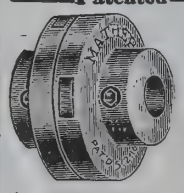

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**Weber Crank-Pin Re-Turning Tool**

**No Filing**
**No Offsetting**
**No Jigs**

This Weber Tool turns all pins absolutely round from one setting of Crank Shaft, on centers. A micrometer dial enables the operator to gauge his cuts and turn all pins to uniform size. The average time required for trueing up one pin is from 5 to 10 minutes. The 4 pins can easily be finished in 30 minutes, and the entire shaft is completed with only one setting.

**The Weber Tool is guaranteed** to turn crank-pins within as close limits of accuracy as any other known method. It will soon save its cost in any Tractor or Automobile Repair Shop. An assortment of cutting tools are furnished. These will fit the pins of most of the popular automobiles, trucks and tractors. Write for Circular and Prices.

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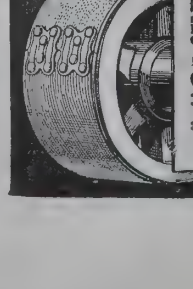

A BELT is no better than its joint. A weak, inefficient joint means a weak, inefficient belt. Use Crescent Belt Fasteners and give your belts an honest-to-goodness chance to "make good". No holes punched. No belting cut away. Full strength sustained. Crescent joints HOLD. Re-making of belt joints eliminated. Continuous production insured. Send for Booklet B on Increasing Belting Efficiency.

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# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.*

## Electrical Devices

EMERGENCY LAMP.—W. J. KOENIG, deceased; address Ralph De Ross, 410 E. 29th St., Brooklyn, N. Y. In order to adapt this lamp for use about machine shops, engine rooms, automobiles or the like it is provided with an electromagnet serving to hold the lamp automatically in any desired position on or against any metallic support. The magnet circuit is a branch of the lighting circuit, and the magnet is energized while the lamp glows.

## Of General Interest

VEGETABLE PEELER.—J. H. HAMLIN, 430 11th Ave., New York, N. Y. Among the objects of the invention is to provide a vegetable cutting and peeling implement adapted to easily and quickly remove the peeling of a potato without waisting that part directly beneath the skin. Another object is to provide a hand-operated implement having a self-contained reservoir of water to flush the surface of the vegetable being peeled, and to provide an abrasive implement with sharp points for removing eyes or faulty portions of the vegetable.

EVER-SET CAGE TRAP.—H. ROHLFF, 332 W. 2nd St., Davenport, Iowa. The invention has reference more particularly to a self-operated ever-set wire cage trap which is especially adapted for trapping birds. The prime object is to provide means for trapping and confining birds without injury. A further object s to construct the trap so that there will be no chance for the birds escaping, yet the trap entrance is always set and capable of operating an unlimited number of times without attention.

RECEPTACLE COVER.—A. SWENSON, 141 Valley Brook Ave., Lyndhurst, N. J. This invention relates to receptacles for holding sugar, fruit or other articles of food. Among the objects is to so construct a cover for this type of receptacle that it may be readily removed from the body in order that all parts may be thoroughly cleaned, thus rendering the article sanitary.

WASHBOILER.—A. T. TIMOSCI, 668 Willis Ave., N. E., San Jose, Cal. The object of the invention is to provide means in connection with wash boilers of usual construction, for supporting the garments to be washed above the bottom of the boiler, the support being arranged in such manner that the garments will be held loosely on the support, and in such manner that the cleansing fluid may flow inward with respect to the support and garments.

WINDOW SEAT.—D. F. CROWE, 1554 Ligonier St., Latrobe, Pa. The invention has for its object to provide a device of the character specified, capable of being seated upon the sill of a window in such position that one seated in the seat may have access to the outer face of the window sashes of the window without danger of falling.

ASH RECEIVER AND SIFTER.—P. H. CHILDRESS, Box 317, Waynesboro, Va. The primary object of the invention is to provide an ash receiver and sifter which will sift the ashes as they are discharged from the grate bars thereby separating the cinders from the ashes, and retaining the cinders in one receptacle and the ashes in the other, to provide for convenient and ready handling.

ANTI-FRICTION BUFFER.—L. LARSEN, Apartado, 150 Tampico, Mexico. The invention relates more particularly to an anti-friction buffer for docks, wharves, ferry slips, ships and the like, which is adapted to absorb the shock of the impact when a ship is being docked, or when two or more ships are lashed together for towing, the object being to prevent damage to the ships from friction.

STORE COUNTER.—F. H. COLE, Yuma, Colo. The invention has for its object to provide a store counter especially adapted for use in grocery stores, for making up orders, wherein the counter has a series of compartments, each provided with a sliding cover arranged to be slid to one end and stood in vertical position, the covers bearing the names of the customers whose order are to be filled.

HOLDER FOR CARBON SHEETS.—W. S. FREEMAN, 55 Worth St., New York, N. Y. The object of this invention is to provide a device consisting of a cap so connected with the end of the sheet that sheets of paper may be arranged on the opposite sides of the carbon sheet with their ends in the cap, to permit the instrument to be written and the carbon copy made while the sheets are so held, a second cap being provided for enclosing the folded sheet and carbon for protecting the same.

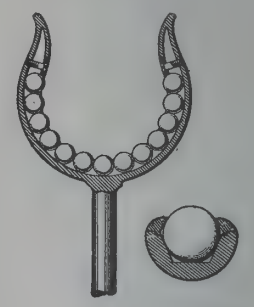
## Hardware and Tools

DOOR HANGER.—B. SPITZFADEN, c/o Elevator Efficiency Co., 51 Maiden Lane, New York, N. Y. The invention relates more particularly to ball bearing hangers for heavy doors. The general object is to meet the severe conditions by providing a construction of parts that will resist heavy strains and at the same time will maintain the door in proper alinement against all tendency to become loose.

STOVEPIPE LOCK.—G. W. HORMEL, 115 N. Wabash St., Wichita, Kan. The invention relates to locks for securing stovepipe lengths together. An object is to provide a simple and effective lock for positively uniting the meeting ends of adjoining stovepipe sections by means of a movable locking member which engages with a stationary member.

WINDOW LOCK.—D. SPIVAK, Room 406, Chamber of Commerce Bldg., New Haven, Conn. Among the principal objects of the invention are to provide a lock of the character mentioned which may be placed in service to provide for window ventilation and secured in such a manner as to prevent tampering with the lock, and to provide a lock the cost of production of which is small.

ROWING GEAR.—D. MCRAE, Central Islip, N. Y. The invention relates more particularly to rowing gear in the form of oar locks, which will reduce the friction incurred by the oar when making the stroke or feathering, the oar lock as constructed having a groove



A FRAGMENTARY VERTICAL SECTION AND DETAILED VIEW

formed in the inner face of the stirrup, and anti-friction members arranged therein, and means for retaining said members in the groove, the anti-friction members constituting a bearing surface for directly receiving an oar.

CLAMP BOLT.—E. J. RUQUET, JR., 1637 Richmond Road, Stapleton, S. I., N. Y. In ship and bridge building, it is often necessary to employ temporary means for holding plates together while the permanent rivets are being driven. The present invention provides a temporary bolt clamp for this purpose. The clamp is simple in its application and may be applied or removed very quickly.

DOOR SPRING.—J. A. CAMPBELL, Carbondale, Ill. This spring is of the type adapted to be concealed within the frame of the door and jamb. It automatically tends to keep the door in a normally closed position and limits to a predetermined degree its outward swing when pushed open. It aso locks the door in its extreme open position.

WELL DRILLING TOOL.—W. A. MCCAUSLAND, 4072 Jenkins Arcade Bldg., Pittsburgh, Pa. The present invention is an improvement in a construction disclosed by Mr. McCausland's previous patent No. 1,211,198. The improved feature of the invention lies in the construction of the stem or middle section of the drilling tool, which includes a tube having a filler with a member embedded therein, the ends of said member projecting beyond the ends of the tube to provide anchoring means whereby the stem is secured to the drill jar and bit respectively.

## Heating and Lighting

FLUE EXTRACTOR.—P. M. CANTY, 909 6th Ave., Altoona, Pa. An important object of the invention is to provide a flue extractor which will so effectively and powerfully engage the flue that the enormous pulling force

necessary to withdraw the flue may be applied. Another object is to provide gripping elements of strong and durable structure, with means for positively withdrawing the gripping elements from engagement with the flue when desired.

TUNNEL KILN.—F. J. LEISEN and E. S. DUNN, 1229 3rd Ave., Huntington, W. Va. The invention relates particularly to the type of kiln known as a tunnel kiln, wherein the articles to be burnt are mounted upon movable carriers, these carriers being intermittently advanced through the kiln and subjected to various degrees of heat so that each carrier with its load enters one end of the tunnel with dried material, and emerges from the opposite end with the burnt articles, which are then subjected to cooling drafts to permit of their rehandling.

SOLAR STEAM GENERATOR.—A. V. FOLSOM, 1121 E. 42nd St., Jacksonville, Fla. An object of the invention is to provide a solar steam generator the principal features of which consists of suitable means for containing water, disposed in such a way as to be heated by means of the rays from the sun through the instrumentality of a reflector for concentrating the rays thereon, means also being provided to turn the reflector in such a way as to always keep it facing the sun.

### Machines and Mechanical Devices

COIL WINDER.—L. F. STRATTON, 21 W. 5th St., Charlotte, N. C. The primary object of this invention is to provide a coil winder by which coils of various sizes and designs may be wound. The invention furnishes a comparatively cheap and simple device which is capable of various adjustments on which the wire may be coiled in a most convenient and practical manner.

CENTRIFUGAL ORE SEPARATOR.—J. A. RICE, Berkeley, Cal. This machine is especially adapted to separate such materials as mineral particles from mill dust, from flue dust, or bag house products, digerent minerals constituting concentrates, liquids differing in specific gravity, and gases such as furnace gases from smelters, where it may be desirable to extract finely divided dust particles, or to separate two gasses differing in specific gravity.

### Medical Devices

MEDICATED PESSARY. — MARTOCCI-PISCULLI, 235 2nd Ave., New York, N. Y. Among the objects of the invention is the construction of a pessary which shall be entirely self-contained, which may be made of any suitable material, and which will have incorporated in it means permitting an evaporable germicidal agent to be associated with it.

### Prime Movers and Their Accessories

AUTOMATIC GOVERNOR.—F. J. BRUMME, Cooksville, Ill.—An object of the invention is to provide an automatic governor designed to be attached to certain portions of an internal combustion engine and actuated by the operation thereof, whereby the flow of fuel through the carburetor is automatically controlled, and can be adjusted at will while the engine is in motion. The device is compact in form and takes up little space.

INTERNAL COMBUSTION ENGINE.—T. B. CASEY, 306 Sewell Apt., Vallejo, Cal. The invention has reference more particularly to means for introducing a scavanging medium in the combustion chamber to effect a complete exhaust of all spent gases incident to the firing of the explosive charge, and thus render the combustion chamber better adapted to receive and fire the explosive charge, whereupon the engine will be capable of operating with a higher degree of efficiency.

VAPORIZER FOR HEAVY OILS.—C. C. MANKER, Mayfair Apts., 40 St. James St., Los Angeles, Cal. This vaporizer for heavy oils such as kerosene and the like, is adapted to be attached to an automobile to furnish the motive power for the same. Means are provided for automatically regulating the quantity of the vaporized products. The oil vapor is mixed with steam which eliminates carbon deposits from the interior of the engine.

### Railways and Their Accessories

SWITCH ADJUSTMENT HOUSING.—R. R. BAKER, 7758 Lagoon Ave., Chicago, Ill. An object of the invention is to provide a housing for switch adjustment that is simple in construction and operation and not liable to easily get out of order. A further object is to provide a casing to prevent snow or sleet from clogging the adjustable connections and preventing adjustments being made until such snow or sleet is removed.

SWITCH LOCK.—P. H. MYERS, c/o Sanatorium, Hainburg, Pa. The invention aims to provide a device by means of which when the point of a switch has once been thrown it would be impossible for this point to shift subsequently unless directly operated by some outside agency. The switch lock is so constructed that it may be operated entirely by mechanical means.

### Pertaining to Recreation

GAME.—H. M. THOMPSON, R.F.D. No. 12, Brownsville, Me. The object of this invention is to provide a device having a game board in the form of a map of some specified country, provided with route lines and with stops indicated on the lines, together with markers for indicating progress along such route lines, the progress of the counters being determined by game pieces, as, for instance, dice.

ROCKING HORSE.—W. DICKINSON, 608 W. Sharpe Ave., Spokane, Wash. The invention has for an object to provide an article of furniture for the use of children. A detachable seat is provided which may be secured to the arm of a rocking chair, an upright formed to simulate the head of a hobby horse, and a clamp for securing the seat to the arm of the chair so that when not in use the device may be removed.

### Pertaining to Vehicles

SLEIGH RUNNER ATTACHMENT FOR BABY CARRIAGES AND OTHER VEHICLES.—H. FLECKL and W. J. BOYD. Address Hans Fleckl, Boyds, Wash. The invention provides a sleigh runner attachment particularly adapted to be attached to a baby carriage. The runners may very quickly be raised to permit the carriage to run on its own wheels or be moved down into engagement with the snow or ice, lifting the wheels from the frozen surface.

VEHICLE WHEEL.—C. E. P. JULIEN, 41 Boulevard Haussman, Paris, France. The invention provides an additional wheel rim applicable to all kinds of vehicles but intended more particularly for tractors, agricultural machines and any motor vehicles required to travel over hard roads and soft ground. The auxiliary rim is provided with V-shaped projections which will project into the ground when traveling over a soft surface but which will not contact with the ground when traveling over a hard surface.

TOOL FOR USE IN REMOVING AND REPLACING TIRES.—V. H. MANKEY, 1110 So. Kline St., Aberdeen, So. Dak. The prime object of the invention is to provide a tool whereby the rim can be quickly displaced or restored in a manner to minimize the possibility of injury to the rim. A further object is to provide a tool that may be quickly placed in position gripping the respective ends of the rim and then the clamps be relatively moved through the medium of an ordinary wrench so that the displacing of the rim or the restoring of the same can be effected in a few minutes.

AUTOMATIC CLUTCH DIFFERENTIAL ESPECIALLY FOR MOTOR CARS.—R. W. A. WARREN, Katanning, West Australia, Australia. The invention relates to an automatic friction clutch differential, which is designed to make use of the considerable centrifugal force or momentum of the car and passengers under which, when turning a corner, the car body and consequently the axle housing tends to continue in a straight course rather than to move with the wheels in the new direction.

PIPE LOCK.—E. BAKLEY, R.F.D., Chatham, N. J. The invention relates to a device for locking a pipe through which fluid is adapted to flow, so as to prevent the passage of any fluid. It is especially constructed for use in connection with an automobile to prevent the theft of the same by cutting off the connection between the gasoline tank and the carburetor but in such a manner that it may be instantly opened by the owner without the use of any special key.

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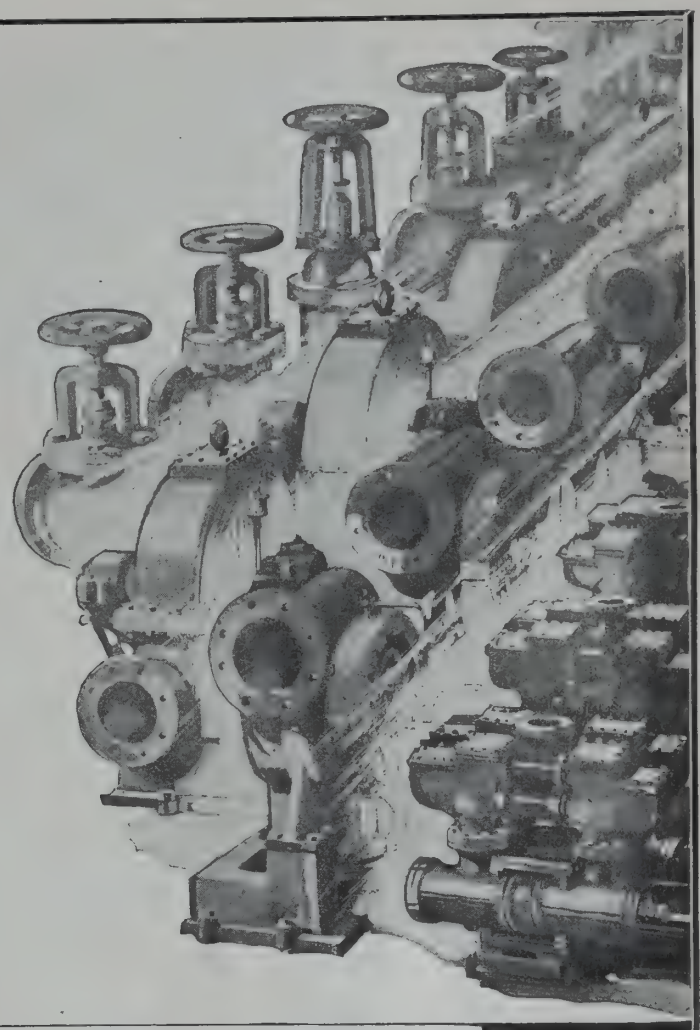

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## The Aerial Cruiser

(*Continued from page 409*)

etc., and the sleeping accommodation consists of hammock bunks. Meals are cooked in special cookers heated by the exhaust from the engines.

### Streamlining and Efficiency

The most careful attention has been given to the design of the cars with the result that a great increase in aerodynamical efficiency has been obtained over the cars of R-33 class airships. By making all the cars of the best known streamline shape, the head resistance as compared with R-33 class cars has been reduced by over 60 per cent, and the utilization of the fine nose of the control car as an observation station for the use of the navigating officer gives exceptional facilities for groundwork, which are not obtained in other designs.

The cars themselves are designed on a principle which enables the weight, as compared with similar cars of R-33 type to be cut down by over 50 per cent with greater strength and rigidity of structure. More roomy cars are therefore provided, the beam of the control car being eight feet as against a maximum of six feet on R-33 class.

### Mooring

Costly experience in the early days of the Zeppelin experiments showed that the greatest peril to the airship occurred when it came near the earth, and several years ago the SCIENTIFIC AMERICAN pointed out that some form of mooring post to which the dirigible could make fast was necessary if landing disasters were to be avoided. The problem has been very ably worked out in the Vickers mooring gear, and R-80 carries in her nose the necessary gear for sailing up to one of these posts and making fast. A covered gangway can be thrown across from the moored airship to the mooring post through which the passengers pass to elevators arranged within the post. Gas, oil and water pipes form a permanent part of the mooring-post equipment, and they are provided at their upper ends with suitable connections for supplying the airship.

## Preventing Rust at High Temperature

(*Continued from page 404*)

shapes, lengths and sizes. Straight pipe ⅛ inch to 18 inches diameter has been calorized in lengths up to 20 feet. There is no limit to the size of material which may be treated. Calorized steel is particularly adapted to pyrometer protection tubes because of the high temperature to which they are exposed. Not only is it cheaper than any of the chrome steel alloys which have at times been offered for this purpose, but it possesses other advantages.

Perhaps the largest and most easily developed field for calorizing lies in its application to the various pots, boxes, tubes, retorts, and special equipment employed in the many heat treating processes. A large quantity of the above mentioned articles have been successfully calorized, their average life being over eight times that of the uncalorized equipment, resulting in a great saving. A notable feature is that calorizing can be applied to any of this equipment without necessitating change in its design or construction.

Many furnaces, kilns, ovens and retorts employed in various manufacturing processes were originally made of iron or steel. This metal has a limited heat-resisting quality and was reduced to scrap in a short time. It was repeatedly replaced, its life being short because of the excessively high temperatures and the same performance continued indefinitely. As the price of the metals increased, the use of the other materials was considered by engineers in an effort to reduce costs. They built these furnaces from fire-brick and various refractory materials. In a great many instances these materials were used at a loss of


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25 to 75 per cent efficiency, but were adopted because the repair costs on iron and steel were prohibitive. Calorizing can be applied to metal furnace lining, baffle plates, etc., the cost of these calorized plates per unit of service being in a great many cases much less than that of refractory materials. There is an unlimited field for calorizing as applied to equipment of this nature.

There are many possible applications of calorized metal which have not been considered, for the reason that only within the last six months has calorizing been available to the commercial world. It is impossible to enumerate or describe in detail the great number of applications. Every plant presents its individual problem and it is the object of the writer to illustrate several applications with the idea of suggesting to the engineer, metallurgist, and plant manager, possible applications to special equipment used in his particular process of manufacture.

## A Pocket Machine Gun

(*Continued from page 405*)

obliged in his work to sit behind various machine guns in erosion, function, and ballistic tests for a matter of six months or more, and he was not impressed at the end of this time with the reliability of function of any machine gun at present used by civilized armies, examples of which we tested. Used under the most favorable conditions, in the hands of skilled mechanics, they all were made to look simply childish in certainty of function and endurance when compared to that other gas engine—the motor of the small car. A stoppage, a broken part, a jam—one of the three would occur with the most reliable machine gun of them all, the Browning, about every 1,000 rounds fired.

One thousand impulses of any given cylinder in the auto motor will, in high gear, run the little car something like a mile, and a hundred-mile run means that each cylinder has fired a hundred times as many "shots" as the machine gun averages between bits of trouble. Not even the most pessimistic of car owners will deny that the motor will run the car a hundred miles without stop, jam, or break.

I cheerfully admit the difference in conditions, such as the far greater pressure of the machine gun and the higher speed of the parts; but still I believe that there is not enough difference in conditions to justify the wide difference in reliability between the two types of gas engines. Possibly, therefore, the decision of the latest entrants into the machine gun market to use lubrication is based on sound judgment. There is also the possibility that they are making a virtue out of a necessity.

The new gun is arranged to fire any pistol cartridge, the change necessary being merely in barrel, magazine and bolt-head. Special cartridges containing buckshot will also function the gun, and make for close-up work a tremendously effective weapon.

The writer, after firing the gun several hundred rounds, would class it as the equal of a score of average policemen firing as the average policeman fires, provided of course the gun were fired by a man accustomed to it. And of course it is far easier to train one man to become expert with the gun than it is to raise the shooting of twenty policemen to the expert stage with their pistols.

There would be no trouble whatever for one man firing the gun to sweep a street clear from curb to curb, but after all, its greatest strength lies in its moral effect. Killing many of the common American sort of mob is unfortunate unless the right ones can be selected for the slaughter. Mobs as a rule are composed of ten per cent vicious (the leaders), and ninety per cent fools. Wherefore the dispersing of the crowds without bloodshed is usually desirable. It would be a most vicious and determined

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Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Thus all these troubles have been constantly increasing, despite the tooth brush.

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8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The Committee of Judges will consist of Professors Leigh Page of Yale and E. P. Adams of Princeton. In the event that they are unable to agree on the best essay, the Einstein Prize Essay Editor will cast the deciding vote.

aggregation that would stand up to the fire of one of these guns, after a couple of bursts had been fired over their heads or into the street in front of them. Moreover, one of the guns, mounted on a patrol wagon or automobile would riddle a car attempting to run by or to escape via the stern-chase route.

The cartridge selected for this gun is a most formidable one. Its bullet of 220 grains is 80 grains heavier than the bullet of our service rifles and machine guns, and its caliber, .45, as compared to .30 ensures that when it hits, it will strike a knock-down blow. The low initial velocity, less than a third that of the service rifle, and the stubby form of the bullet prevents it from having much range; which lack of carrying power is a most desirable thing in settled communities. The Ballistic Station found the extreme range of the cartridge to be 1,400 yards, with 500 yards as probably its effective range.

The locking bolt of the arm is worthy of notice as embodying a new principle in machine gun and self-loading arm mechanism. It consists of a wedge, sliding nearly vertical, and locking the barrel extension and receiver together. Its slots are cut at an angle of about 80° with the axis of the barrel and its extension. It was found years ago by Commander Blish of the United States Navy, the inventor of the device, that a wedge so arranged would hold while the breech pressure of the exploding cartridge remained high, but the instant or as soon as the bullet left the muzzle, the adhesion between wedge and its slots ceased, and the remaining backward pressure would compel the wedge to slide downward and unlock the breech mechanism. The principle applies to other forms of breech mechanisms, where the locking is done by cams without a final bearing at right angles to the line of backward thrust.

Thus, some years ago, a coast defense gun, firing blank cartridges, giving of course low pressure, insisted upon unlocking itself and coming open each shot.

This was very alarming because it was apparent that if the breech would cam itself open during the firing of low pressure blanks, then fireworks and trouble could surely be expected when firing high pressure service charges.

On trial, however, it didn't work out, the gun stayed locked beautifully with the service and high pressure charges. Here evidently the adhesion of the locking surface set up by the high pressure charge did not free in time to permit the subsequent falling pressure to unlook the gun and open it.

The writer found the same phenomenon when testing a well-known sporting rifle with greased cases. This rifle has a locking bolt which works in slots cut at nearly right angles to the horizontal bolt. The finger lever operating the mechanism normally has a catch to hold it closed, but here the catch was broken, the parts were worn and free and the case itself was greased.

The result was that the horizontal bolt would open during the firing, drawing the fired case with it. It did not "blow" open, that is it did not open during the height of the pressure and permit the escape of gas; it came open when the pressure had evidently fallen enough to free the locking surfaces of the vertical bolt, and permit the little remaining pressure to drive the breech bolt backward. The Ross sporting rifle was another weapon which would at times perform this trick if the rocker arm on the sear, which normally holds the sleeve closed, were removed, or was too short to reach up on the pulling of the trigger and hold the sleeve from backward movement. In this case, particularly with the cartridge case greased, the sleeve would slide open, taking the case with it. This was not a violent action, and there was no evidence of high pressure or gas. It was evident that when the gas pressure in the chamber fell, the bolt would cam open, just as did the interrupted-screw block of the coast defense gun referred to.

In the Submachine Gun, the joint invention of General John T. Thompson, retired, former Chief of the Small Arms Division during the war, and Commander Blish of the Navy, this same principle is used, the wedge locking bolt holding firmly while high pressure persists within the chamber, unlocking when the pressure falls, and permitting the bolt to slide back and the various parts of the mechanism to function.

It is question how much friction enters into this sort of locking arrangement, and therefore how much of the oiling system adopted is a matter of necessity.

The fact remains that the gun functions at extraordinary speed and with more than normal machine gun reliability. With its small size, its light weight, its tremendous rate of fire, and its ease of control, the recent New York acquisition is probably the most efficient man killer of any firearm yet produced. A well-known American factory is producing 15,000 of them—destination and purpose not announced.

## What Science Did for Cheese

(*Continued from page 406*)

record although much of this native product was of low grade. With the perfection of new commercial system of cheese manufacture, not only is dairying promoted in sections of the country far from city markets and adequate railroad transportation, but the standardization of Swiss-cheese-making also promises that we will produce our potential supplies at home and also may devote considerable of our surplus to export trade. At present one plant in California is manufacturing Swiss cheese on a large scale according to the new system of production. This factory will produce over $2,000,000 worth of Swiss cheeses this year while it has already exported two carloads of the product to Switzerland where the cheese was sold on the open market and was complimented as being better than the best of the domestic offerings.

Another notable accomplishment of the National Dairy Division has been the perfection of modern methods of Roquefort cheese production so that this delectable delicacy can be made from cow's milk and cured under artificial conditions, the finished product being as good as, if not better than, the expensive, imported Roquefort which comes from France and is made from sheep's milk. For twenty centuries, Roquefort has ranked as the king of all cheese. It has been made by the peasants of southern France who live near Roquefort and maintain approximately 500,000 sheep especially for the production of milk from which to make the cheese. During their six months' lactation period some of the ewes produce enough milk individually to make 50 pounds of cheese. The cheese, for the most part, is made on the farms and small factories of that neighborhood and subsequently sent to Roquefort where it is cured in the famous caves of that region—formed by the slipping of rock at the base of the Cambalou Mountains.

Currents of cool moist air circulate freely through the caverns and galleries and are aided in their natural refrigeration and curing of the cheese by the numerous streams of mountain water which wind hither and thither among the grottos. When the moist air currents strike the rocks, rapid evaporation occurs which is invaluable in lowering the temperature to about 40 degrees Fahrenheit. During recent years some of these natural subterranean ice-boxes have been enlarged and equipped with artificial means of refrigeration so that even lower temperatures than naturally obtain can be produced. The fact that cheese is produced at country points and concentrated at Roquefort

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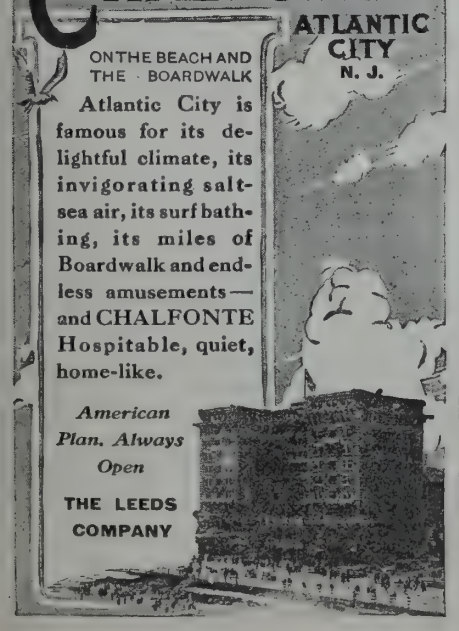


for curing suggests a possibility for the improvement of the manufacture of similar cheese in this country and the ultimate assembly of all the material at one central point for curing. Such an arrangement would minimize the expense and also would operate for the production of a superior quality product of uniform grade.

The Federal farming scientists in this country, for a number of years, have been experimenting with the potential purpose of perfecting the manufacture of a green mold cheese from cow's milk. For many years the attempts all resulted in failure and the experts ascertained that it was not sufficient merely to sprinkle green mold on the curd to produce Roquefort cheese. It was only with the greatest difficulty that the mold was made to develop properly; this process, at best, was very unreliable while available systems of refrigeration were not adequate, subsequently, for the proper curing of the dairy product. A low temperature was prerequisite, with plenty of ventilation and high humidity.

Finally, the Government dairying specialists devised a special air-conditioning apparatus which filled the bill to a T and which duplicated the natural conditions which obtained in the caves of Roquefort. As a result of this invention combined with the perfection of a process which permitted the substitution of cow's milk for goat's milk—as little of the latter material was available in this country—modern science has standardized Roquefort cheese manufacture and adapted it to our local conditions as efficiently as it solved the Swiss cheese riddle.

Before giving world-wide publicity to its new discoveries, the National Department of Agriculture produced both Swiss and Roquefort cheeses on a commercial scale for wholesale and retail trade at the Grove City, Pennsylvania, creamery, which is operated under the coöperative direction of Uncle Sam. During the last couple of years this cheese has been sold on the open market in active competition with the best grades of imported cheese with flattering results indicative of the superiority of the domestic product. In the case of the Roquefort cheese, some slight criticism has developed due to the fact that the color of the cheese made from cow's milk is yellower than that of the imported Roquefort made of goat's milk. This obtains from the fact that the fat of sheep milk naturally is whiter than that of cow's milk. However, it is anticipated that, as the domestic industry develops and more scientific attention is devoted to the study of cheese manufacture, additional perfection and improvements will result which will eliminate all existent sources of unfavorable comment.

## Safety for the Linemen

(*Continued from page 407*)

slightest pinhole or other defect that might admit of the passage of an electric discharge through the glove.

Each glove is filled with water to within about two inches of the top, being soused in the water for an equal distance from the top. Scientifically expressed, one terminal of a "step-up" transformer is then connected to the water inside the glove and the other to the water outside the glove. By the application of a regulating and measuring apparatus, not shown in the accompanying photograph, the voltage is raised to the specified value and maintained for five minutes, or until the glove "breaks down" or yields to the electric stress. The fact that occasionally several gloves in a single consignment cannot withstand the searching eye of the experiment emphasizes the value of periodic tests.

Rubber gloves purchased by Uncle Sam for use at the Panama Canal are tested by the Bureau of Standards before they can qualify for service. The stress is applied at 9,000 volts, a voltage higher than that required by active usage. Similarly, progressive electric power companies have

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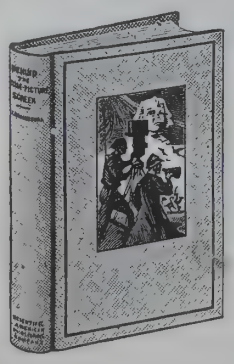

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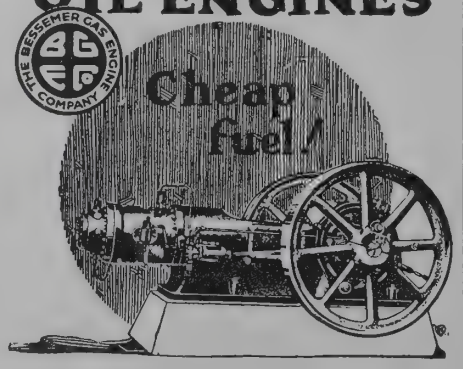


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### Propping Fruit Trees with Staples and Wires

THE fruit tree with a fruit load much too heavy for its own trunk and limb structure isn't an unusual occurrence in either the small home orchard or the big commercial one. The common way of providing supports for such trees is to use wooden props, sawed out of scantlings. When wooden props first were used, lumber was cheap and easily obtained. This condition has radically changed, and the cost of props, used in any number, is a serious additional cost. Another drawback to props is that they require frequent attention. A storm comes, the wind blows hard—and props are down all through the orchard. When props are used, cultivation beneath the trees is interfered with.

Propping with staples and wires is a growing practice in California fruit districts. It is a method which requires some skill and judgment, but when properly done is economical and efficient. One wiring does for several years. The cost of the method is only a fraction of what propping with wood costs.

California expert orchardists find that the best time to prop is just before the fruit tree branches have become to bend under their load. In wiring, the endeavor is to attach wire to branches at the point where the center of the load will come. Two methods can be pursued. One is to have a central iron ring, within the tree, with wires running from it to the branches needing support. An advantage of this method is that if a wire breaks, only one branch is released.

For most trees, however, the more practical method is to run one wire around the branches requiring support, holding them in and together. Twelve or 13 gage wire is used. Fourteen gage is too light, while an objection to 12 gage is that, though very strong, it is hard to handle. So growers frequently compromise and use 11 gage. The wire is attached to the limb with a two-inch fence staple, except in the case of very small limbs, when a large picture screw-eye is used. Screw-eyes are used when a staple would split the wood.

In wiring, the endeavor should be to hold the tree in its natural position. If this is well done, the growing load of fruit will operate simply to strengthen the tree in its proper shape. If the [illegible] is not well wired, there is still [illegible]nger of damage from spreading when the full load begins to be felt.—By *J. T. Bartlett.*

## "All Right, Then—I'll Go To Hell!"

"It was awful thoughts and awful words, but they were said and I let them stay said."

It had felt good to be all washed clean of sin and to be able to pray—but Huck couldn't tell Old Jim no matter how sure it would make him of going to Heaven.

So he tore up the note and swore he would never reform again. He would steal Jim out of slavery, he would—and if he could think up anything worse, he'd do that too. As long as he was going to hell anyway, he might as well make it worth while. Who ever knew the heart of a boy as does

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*A Weekly Review of Progress in*

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MELTING GOLD COINS IN THE UNITED STATES ASSAY OFFICE.—[See page 429]

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October 23, 1920

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Price 15 Cents
20 cents in Canada

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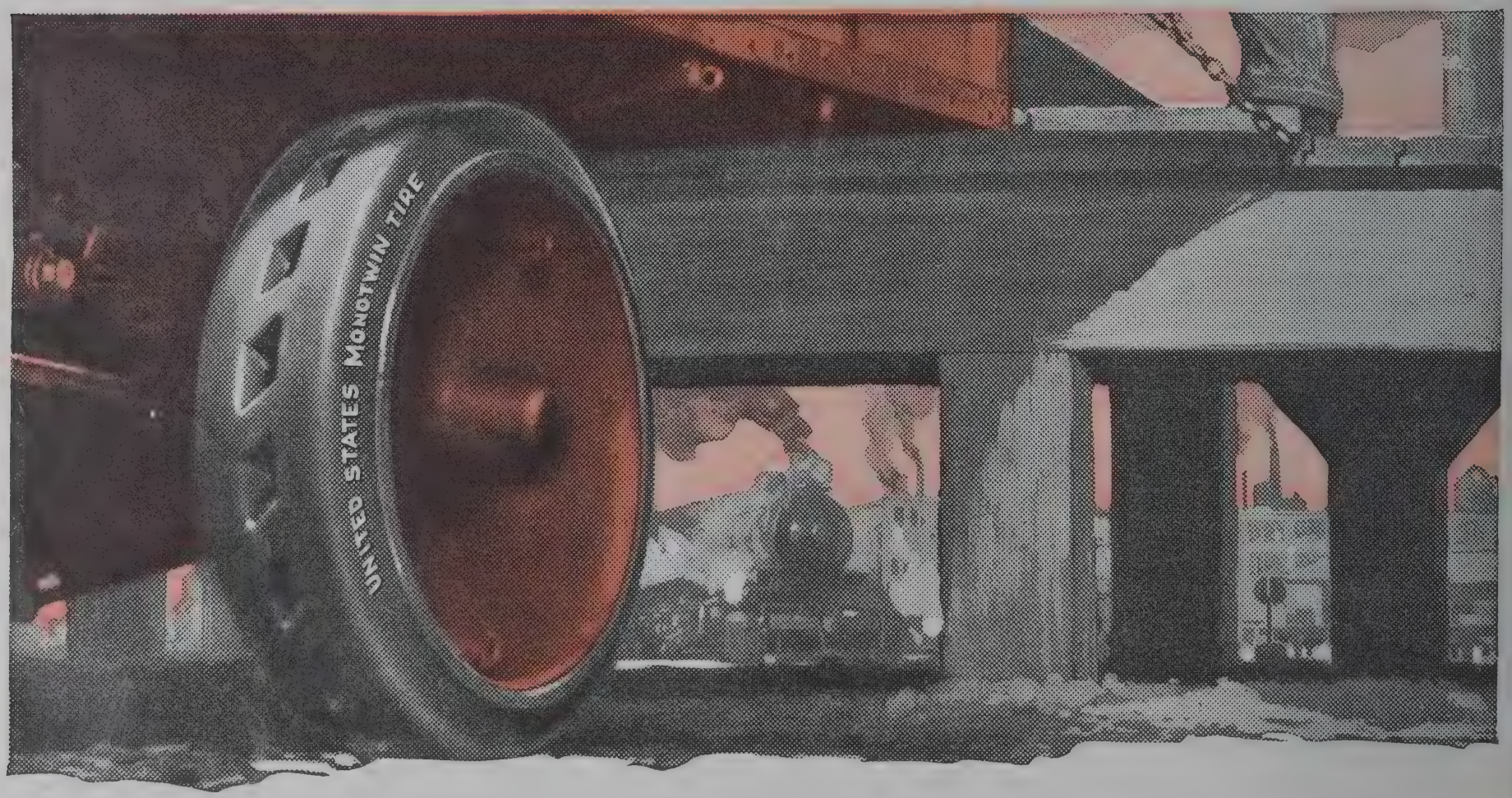
# The Fastest Selling Solid Truck Tire in America — the MONO-TWIN




TALK to the truck owners of this country about *economy*—even an economy that may not be immediately apparent—and you will always find them ready and willing to listen to you.

When the United States Rubber Company announced the creation of its new Mono-Twin Solid Truck Tire, two months ago, it expected that truck owners would be interested.

What it didn't foresee was how quickly and almost universally they would appreciate the *results* towards which this company had been working.

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For those who overlooked the first announcement regarding the Mono-Twin, we reprint these few facts bearing on its economy:

It is built of *grainless* rubber—an exclusive U. S. creation—*non-splitting.*

*Chemically* joined to its base—ending base separation.

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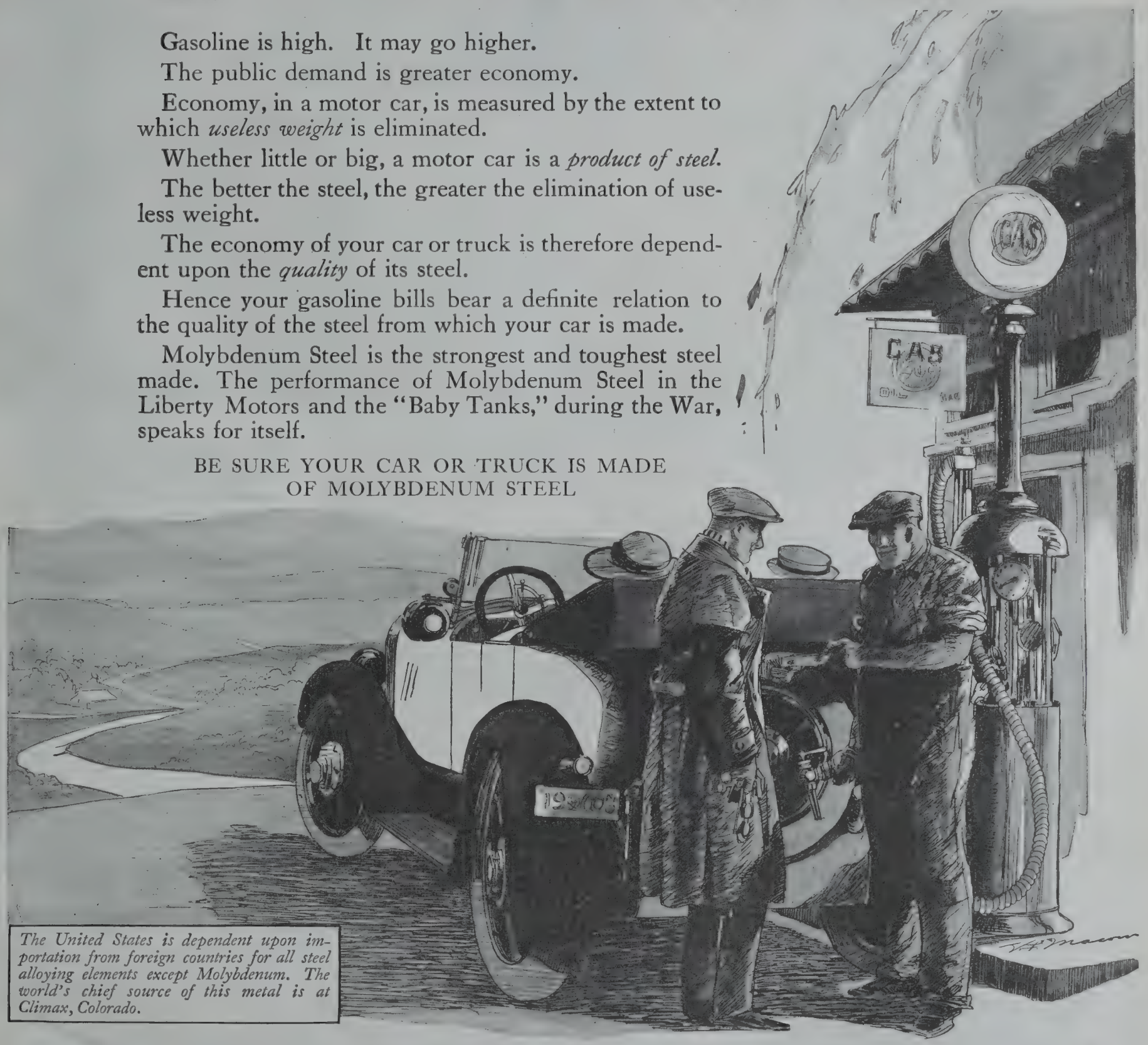


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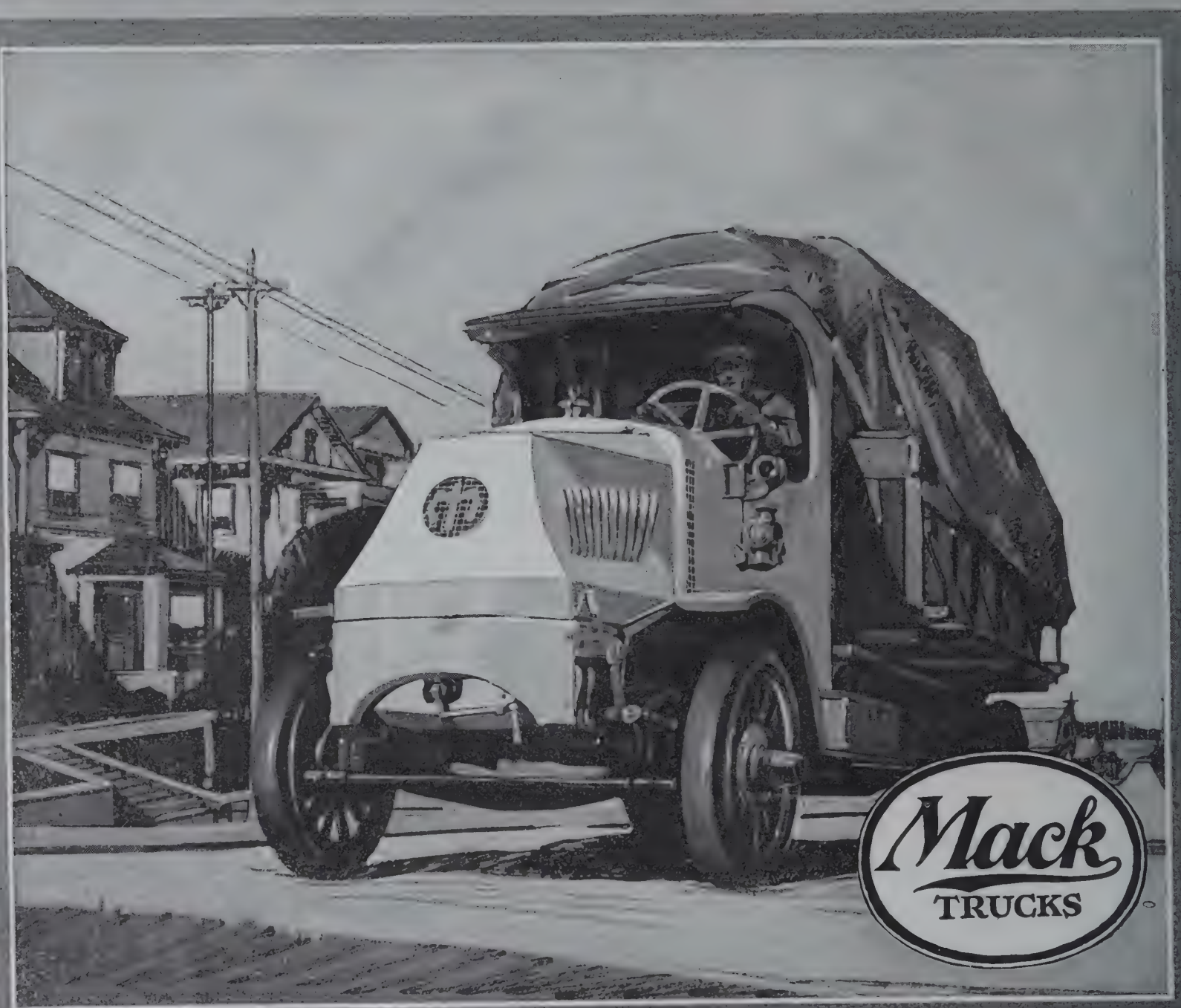


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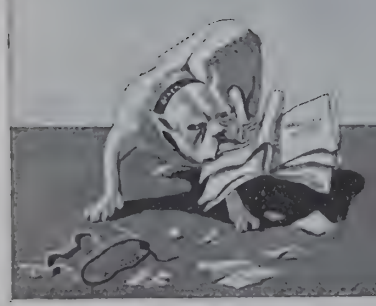

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1. Chaise longe, made up from two of the chairs. 2. The bed for two persons. 3. Table, chairs and bed arranged to form an attractive living room and dining room combined. 4. Cupboard of the table opened to reveal the kitchen equipment. 5. Another cupboard of the table opened to show additional cooking utensils, as well as the sewing machine on the side.

**The compact household which packs into a trunk or case yet which has all the comforts of the modern home**

## The Household That Packs into a Trunk

CONDENSED households seem to be the order of the day. A few years ago the world was accustomed to spacious homes in city and country alike. But with the housing shortage there has come a sharp retrenchment in household space, and ingenious architects are busily engaged in planning small and still smaller rooms in both new and old houses, while clever and enterprising inventors are developing convertible and nesting furniture which can be used to the best advantage in the small space now available.

The old scheme of one room for one purpose—the dining room, sitting room, bedroom, and so on—is fast going out of date. There is afoot a very definite tendency to make every room serve for several different purposes. Thus we find the living room replacing the parlor or sitting room, and this same living room not only serves throughout the day but is also provided with a davenport or other form of bed for use at night. At least one company engaged in manufacturing ready-cut houses is now featuring small houses in which every room, by means of closets and other devices, can be used for a variety of purposes. This is truly condensed housekeeping, is it not?

Now comes a young French inventor, M. Louvet, with an entire household which, when completely packed, measures 49 by 54 by 33 inches, thus permitting it to be packed in the large trunk or to pass through any door without difficulty of any kind. Yet the five pieces of furniture contained in the case cover a floor space of 78 by 103 inches when spread out. In these pieces are contained all the other combinations and accessories for the household.

An inventory of the Louvet compact households reveals the following items: A bed for two persons; metal bed spring, mattress and necessary sheets and other bedding; a child's cot, with springs and bedding; a table 49 by 30 inches; a side board with dishes for three persons; a pedal-operated sewing machine; a linen closet containing all the linens necessary for the household and a child; a chaise longe; two chairs for adults; a child's chair; a folding stool for adult and another one for a child; a children's bench; a piece of furniture serving as desk and dressing table; a revolving stool with a shaving glass attached; a lady's mirror; a lady's sewing table with all accessories; a carpenter's and metal worker's tool box; a stove for heating; a clothes-washing outfit with large tub that can hold as much as 130 quarts of water; and all accessories for a home such as lamp, pictures, clothes hangers, etc.

The table, which is shown in three of the accompanying illustrations, contains all the kitchen accessories. There is also a sewing machine which folds up on one side of the table, as shown. There are several drawers for odds and ends. Each object has its special place in a compact form, so that nothing rattles or falls out.

With two of the chairs a chaise longe is easily made. All the chairs contain compartments which hold all the necessaries for a bedroom. The double bed at the bottom has drawers and cupboards containing other accessories.

## Changes Rule of Road

THE automobile brought with it in British Columbia an agitation to change the rule of the road, and spasmodically in this Canadian province for a dozen years there have been organized efforts to bring about the change. Along with Prince Edward Island, British Columbia has always "turned to the left," after the English fashion, since the days of first settlement. The rest of Canada followed the American rule of the road, which is also the Continental.

The British Columbia government decided at the last session of the Legislature to adopt the American rule, and the change will soon be put into effect.

Chief opposition to the change was from the electric railways, who claimed that heavy expense in altering equipment would be unavoidable. There were also the usual arguments that the "natural" way to turn is the left. Turning either to the right or to the left, experience shows, is largely a matter of habit, quite easily acquired, and with the advent of the automobile the most cogent argument for turning to the left—namely, that it enables the driver, sitting on the right, to watch the wheels in passing—has lost great caste. This objection to the right-hand drive caused automobile manufacturers to change to the left-hand drive, and the objection no longer existed.

In any event, British Columbia decided that it would be fairly simple for its population to "learn over" a rule of the road, to break itself of the old habit and form a new one. Surrounded by peoples using the American system, and with the automobile and automobilists from outside always urging standardization, British Columbia decided the practical move was to change the rule.

Historians say that charioteers in Roman arenas turned to the left, and that the legions of Severus, marching through Britain, kept to the left.

## New Use for a Rare Element

NEW uses for rare metals or elements seem to be appearing constantly. The metal selenium is not a familiar one but is a by-product in the electrolytic refining of copper. Demand for it has been very light and its chief use has been in the glass industry, in photographic chemistry and in medicine. It has also been used to a limited extent in electrical work, because it possesses the peculiar property of varying conductivity according to the intensity of the light. Under the influence of light its conductivity may be 500 times greater than in the dark. As the result of research work carried out at the University of Wisconsin by Prof. Victor Lenher, a new property has been discovered which should open up a big field for the application of selenium and incidentally make it worth while for copper refiners to pay more attention to its recovery. In the form of selenium oxychloride it acts as a powerful solvent on certain organic substances. The unsaturated hydrocarbons, such as acetylene, benzene, and toluene, dissolve readily, while the paraffin hydrocarbons, such as gasoline, vaseline, and paraffin wax, are unaffected. Pure rubber, vulcanized rubber, asphalt, bitumen, and the casein glue used in airplane construction dissolve easily in selenium oxychloride, and it can be used in coal analysis to extract the bituminous material in soft coals.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Freight Handling and the High Cost of Living

IN view of the number and diversity of the causes which are given for the present high cost of living, it may well be that the only fact of which the average citizen is absolutely sure is that the cost is high. As a matter of fact, present conditions result from a multiplicity of causes, some near at hand and readily recognized; others, so far as public observation goes, being more remote and liable to be entirely overlooked. Among these may be classed that part of the high cost of living which is chargeable to out-of-date and inefficient methods for the handling of freight at railroad and steamship terminals.

It is an amazing fact that in the land which is preëminent for the manufacture of labor-saving machinery, we should be making less use of such machinery in the matter of freight handling than some of the leading countries of Europe. How this condition has been brought about it would be interesting to discover, but probably we shall not be far from the truth if we say that it is traceable to that pronounced spirit of conservatism which in this matter of freight handling, as distinct from freight hauling, has dominated our transportation interests both on land and sea. This, however, is an explanation which does not explain; for in the hauling of freight, once they have got it on the cars, our railroads have shown a characteristic American ability to cut down costs by continually enlarging and improving their locomotives and cars; so much so that, today, we are hauling freight at a cost that is far below that of any country of the world.

Why is it that in the bringing of raw materials to our factories, in working these materials up into finished products and in hauling them from the factory to the consumer, we have developed handling machinery famous the world over, and yet have failed to make any commensurate use of such machinery in the handling of package freight at terminals and transfer points, both on our railways and at our great seaboard terminals?

How greatly the high cost of living is affected by failure to make full use of labor-saving appliances in the handling of mixed and package freight is shown by a comparison of the costs of hauling freight once it is upon the cars with the cost of handling it at the point of destination. Thus, we are told by Harwood Frost, writing in *Marine Engineering*, that the average expense of hauling a ton of freight 240 miles is 74 cents, while the average expense of handling the same ton of freight at the terminals is 75 cents, and he quotes as an example the case of the short haul between Philadelphia and New York, where the cost of handling at the terminals is $3.65, whereas the railroad cost for the 90-mile haul is only 27 cents. We are told that it costs less for the 1,300-mile marine haul from Havana to Boston than it does to transfer the same freight from one pier in Boston Harbor to another. Similarly, it costs more to transfer a barrel of flour from the car to the hold of a ship in New York than it does to carry it by that ship from New York to Liverpool.

The country is now engaged in one of the greatest commercial enterprises in its history, upon which it has already expended considerably over three billion dollars. We refer to the activities of the Shipping Board and the great fleet of over six million gross tons which the Board now has in its care. With this equipment we are endeavoring to win our proper share of the deep-sea-carrying trade of the world. In this effort we shall have to match our wits against the nations which, through long years of experience, have become thoroughly efficient in the building and routing of ships and who have established on a comprehensive scale all the complicated machinery which is necessary for the gathering and distribution of world-wide trade. We are handicapped by the fact that we have to build our commercial structure from the ground up, and we are under the severe handicap imposed by the obligations and restrictions of the Seamen's Bill.

Our crews are better paid, better housed, and by law we are obligated to carry a larger number of men than our competitors carry on a ship of the same tonnage. The only direction in which we can look to overcome the handicap against us is in the reduction of the turn-around by shortening the time which shipping must spend in our ports, and the most effective way and the only way in which this can be done is by utilizing to the utmost limit the various labor-saving devices such as electrical cranes, hoists, conveyors, tiering machinery and other handling devices that are used so extensively by our foreign competitors.

We understand that the Railroad Committee of the Chamber of Commerce of the United States has been making a study of this most vital question, and that constructive recommendations will shortly be made relating to the question of freight handling at terminals. Necessarily this will include both railroad and marine transportation. The report should be most widely distributed and a campaign of education undertaken with a view to getting the constituents both inland and on the seaboard to urge upon their Congressmen the need for taking hold of this vital question at once and with a liberal hand.

## Motor Trucks and Country Bridges

IN view of the rapid increase in motor truck service in rural districts it is high time that the authorities looked into the question of the strength of the smaller country bridges and their ability to stand up under the increasing stresses to which they are being subjected by the weight and speed of motor truck traffic.

The benefits which have been conferred upon outlying farming communities by the rapid spread of the new system of freight transportation are so apparent, that it is certain, not only that rural motor truck service has come to stay but that it will be enormously extended. Not only will the total freight carried grow rapidly, but there will be an inevitable increase in the size and speed of the individual trucks.

The art of road building has progressed to the point at which we can construct roadbeds that will stand up under the most exacting service; but we question whether the bridge builder has kept pace with the road builder. It is certain that a careful survey of country bridges, made by competent bridge engineers, would discover hundreds of structures that are being stressed beyond the limits of safe and conservative practice.

In this connection we wish to draw attention to a most important element in bridge design, which only of late years has begun to receive the attention which its importance demands. We refer to the question of impact. It is only now beginning to be realized that, even in steel bridges of the first magnitude, the difference between the stresses due to static as against dynamic effect may be enormous. A train moving very slowly across a bridge is one thing—the same train rushing across the structure at from forty to sixty miles an hour is quite another, and the increase of the stresses due to the hammer blow of the flying mass, may concievably be from fifty to one hundred per cent.

The difficulty of making an exact determination of the dynamical effects of impact on the members of bridge structures is due, in part, to the want of suitable appliances. Laboratory tests on small-scale structures would teach us something; but we doubt if the data thus secured would be accepted by engineers as a sufficiently reliable indication of the actual impact stresses in the full-size bridge. The successful results of the investigation by Mr. Fowler of the Niagara Bridge suggest that the impact problem may be solved along similar lines. There is considerable divergence of opinion among bridge engineers; but it is probable that impact stresses increase as the square of the velocity of the moving vehicle.

Undoubtedly the effects of impact are felt most severely by the floor system, and proof of this is seen in the fact that, in the cases where country bridges have given way, it has generally been the floor system (floor beams, stringers or planking) that has failed. Instances of the complete collapse of the trusses are comparatively rare.

A survey of the highway bridges of the country would show that, although the trusses are generally sufficient for their work, many of the floor systems should be rebuilt. And in connection with this matter of impact, we wish to emphasize the importance of maintaining a true surface on the planking. To replace a worn down plank with one of the original thickness results in a heavy impact on the bridge, when a five-ton truck, running at twenty miles an hour strikes the obstruction—for such it is. The new plank or planks, as the case may be, should be adzed down to match the general surface.

We commend this subject of impact on highway bridges to the attention of road commissioners as one which calls for immediate action. Fast freight motor traffic, we repeat, has come to stay; our highways are equal to the new conditions, but too many of our highway bridges are not. They can be made so by a partial rebuilding at a cost that would not be excessive.

## The Hudson Vehicular Tunnel

A RED letter day in the history of urban transportation was October 12th of this year, when Governor Edwards of New Jersey and Lieutenant Governor Walker of New York broke ground at the New York end, thereby inaugurating the construction of the vehicular tunnel beneath the Hudson River, the first great tunnel of its kind to be constructed in the new world. Tunnels of this character have been built before, notably the Rotherhithe Tunnel, London, and one beneath the Elbe at Hamburg. But these two, because of their shorter length, are not burdened with the great problem of artificial ventilation, which renders the construction of the Hudson River tunnel so formidable an undertaking.

The twin-tube structure will measure nearly one and one-third miles between end portals, and the outer diameter of each tube will be 29 feet. The Rotherhithe Tunnel has a span of 1,570 feet between the ventilating shafts, whereas there will be a stretch of 3,800 feet beneath the tide and between the off-shore ventilating shafts. Of these last-named there will be four, two near the pierhead lines and two inshore, near the tunnel entrances and exits. A cross section of the tubes shows that they will be divided horizontally by two partitions, the upper chamber being used for the outflow of the foul air, the lower chamber for the inflow of fresh air, and the middle chamber being devoted to traffic. The roadbed will be 20 feet wide, with a clearance of 13 feet 6 inches between the floor level and the under side of the ceiling.

To ventilate the tubes there will be provided 65 electrically-driven fans which will be sufficient to effect a complete change of the air 32 times every hour. The operation of the ventilating system at maximum capacity will call for the annual expenditure of $280,000. The traffic is estimated for the first year at 119,000 horse-drawn vehicles and 2,686 motor vehicles, and in the tenth year, the figures show a potential one-tube traffic of 68,000 horse-drawn as against 5,916,000 motor vehicles. Twenty years from the opening of the tunnel, it is estimated that the dual route should be handling a total of 15,800,000 motor vehicles in the twelvemonth.

The cost of the tunnel is now put down at $28,669,000, which will be equally divided between the two States. It is expected that, in eleven years, the operating revenue will have yielded sufficient income to amortize the cost of the tubes, and that at the end of twenty years each State will have to its credit a surplus of $33,635,000, or sufficient to build another double-tube tunnel. In three and a half years the tubes should be open, and the intolerable congestion and delay of the present ferry service will, mercifully, become a thing of the past.

## Electricity

**A Plug Bushing Which Grips the Cord.** — For taking the strain off the binding screws of plugs a new bushing has been developed by an electrical manufacturer. The hole in the bushing has a number of inwardly projecting bosses which serve securely to grip the outer surface of the wire around its entire circumference. Thus the strain on the wire is taken by the bushing and not by the binding screws. The threading is standard ⅜-inch iron pipe size. It is therefore possible to attach the cap to socket handles, etc.

**A Self-Cleaning Lighting Fixture.** — An electric fixture which cleans itself every time the light is switched on or off has been placed on the market. The fixture consists of a reflector, a pull switch, a cord, and a cleaning device comprising two wiping blades. Every time the cord is pulled to operate the switch it simultaneously brings the two wiping blades into action. Each blade makes a complete revolution, one against the reflecting surface of the reflector and the other against the lamp bulb. In this way the dirt is swept off both lamp and reflector.

**Combination Fan and Heater.**—There is nothing new in the idea of using an electric fan for the purpose of distributing heat about a room, but no one had attempted to combine the electric fan and the electric heater until the advent of the recent device. This device is a standard fan, to the guard of which is attached a nichrome heater. The fan and the heater have independent connections, attaching to any socket, and combined, in the domestic size, require 600 watts. The fan-heater is made in larger sizes for industrial purposes. In summer time the fan alone is operated, so as to serve for cooling purposes.

**Briquetted Plates for Storage Batteries.**—A new type of storage battery is described in a recent issue of *Science Abstracts*. This new battery, which is of Swedish origin, appears to be a modification of the nickel-iron alkaline cell as made by Junger, the chief characteristic being the method of making up the plates from briquettes of active material, which are automatically fed in between two perforated nickel-steel strips. These strips inclosing the active material are manufactured in lengths folded together and fitted into a steel frame. The complete electrode is then put through a rolling process to ensure perfect contact between the active material and the strips.

**Radio Telephone for Seaplanes.**—It is reported that the U. S. Navy is now making use of radio telephone sets for seaplanes with which a transmission radius of over 150 miles has been obtained. The transmitter radiates at two wave lengths, 1,600 and 600 meters. For the former wave length a trailing wire antenna of 0.0004 mfd. is employed, for the latter an emergency aerial of 0.00026 mfd. The transmitter is supplied with two three-electrode tubes of the pliotron type. One tube is employed as an oscillator for the production of radio-frequency currents and the other tube is employed as a modulator and as an amplifier of the voice currents that are communicated to it by the microphone.

**Coolidge's X-Ray Tube.**—A summary of a lecture delivered by Dr. W. D. Coolidge before the Röntgen Society in England appears in a recent issue of the London *Electrician*. It was said that progress in the development of the X-ray tube was possible only when the art of manufacturing and working tungsten had been mastered. Dr. Coolidge dwelt in considerable detail on the present method of purifying and reducing wolframite and the operations of sintering the powdered tungsten metal into blocks and plates from which disks could be prepared, when white hot, suitable for the targets of X-ray tubes. The essential requirements of a target in an X-ray tube were stated as follows: (1) A high melting point to permit sharp focusing of the cathode rays without fusing the target. (2) A high atomic number to secure a large yield of X-rays. (3) A high thermal conductivity to enable the heat to be got rid of. (4) A high heat capacity to withstand intense momentary discharges as in diagnostic work. (5) A low vapor pressure to prevent the metal being deposited on the walls of the bulb.

## Astronomy

**Masses of the Nebulæ.**—One interesting corollary of the epoch-making studies of nebulæ recently carried out at Lick Observatory, and reported in Vol. XIII of its publications, is that the rotational velocities of several bright-line nebulæ, as determined with the spectroscope, serve, with certain assumptions, to indicate the masses of these bodies. In three cases the masses indicated are 162, 3.7 and 18.8 times that of the sun. The planetary nebulæ in which rotational effects have been observed appear to be at least several times as massive as the sun, but the fainter and apparently smaller planetaries are probably less massive, in some cases, than the solar system.

**The Subterranean Clock Room** of the Argentine National Observatory is described by M. L. Zimmer in the *Astronomical Journal*. This room is interesting for the reason that it maintains a constant temperature without any auxiliary apparatus. A hole 10½ meters deep and 2 meters in diameter was sunk and the room was constructed of re-enforced concrete, treated with a water-proof mixture. The Riefler clock in the observing room is synchronized with one of the two standard clocks underground, so that there is never any necessity for descending into the lower room. Surface vibrations have little or no effect upon the room, but earthquake shocks would stop the clock, and there appears to be no remedy for this difficulty.

**Interchange of Wireless Time Signals.**—A large part of the May, 1920, number of the *Monthly Notices* of the Royal Astronomical Society (published in July) is devoted to articles on a subject now very prominent in astronomical circles; viz., the exchange of wireless time signals by the great observatories of the world. Some of the objects to be attained by concerted work in this line are thus set forth by Professor Sampson: (1) A more exact knowledge of longitudes, implying the final settlement of the most obstinate of geodetical problems. (2) Consistency in time determination throughout the world. (3) Elimination of small remaining errors in systematic right ascensions of stars. (4) Improvement in the knowledge of clocks as timekeepers and as chronographic instruments. (5) Some reaction to the benefit of radio research. Great progress has already been made in apparatus for obtaining autographic registration at the observatories of time signals from high-power radio stations in remote parts of the world. Thus Greenwich Observatory now regularly records the signals from Paris, Nauen, Lyons and Annapolis, and occasionally those from Darien. Efforts have been made, without success as yet, to detect at Greenwich the signals from San Diego, Cal., and Honolulu. An international program will probably be adopted at a meeting of the Commission de l'Heure in 1922.

**The Total Solar Eclipse of September 20, 1922.**— Plans are being made to utilize this forthcoming eclipse for a further test of the Einstein hypothesis, for which purpose it will be more suitable than the eclipse of 1923. The field of stars in which the sun will be located at the time of the eclipse has recently been photographed with an astrographic telescope stopped down to 7 inches aperture, using rapid plates, and a diagram of the field is published by the British astronomer royal in the *Monthly Notices* for May, 1920. Information concerning possible stations for observing the eclipse has been communicated to the Royal Astronomical Society by Mr. A. R. Hinks. There are three convenient locations: (1) Bandidu, in the Maldive Islands, is on the central line, with a duration of 4 minutes 10 seconds and an altitude of 34 deg., at which good photographs may be obtained. It has the advantage of occurring at 8:10 a. m., local time, before the temperature has risen; there will consequently be little or no fall in temperature during the eclipse. (2) Christmas Island, in the Indian Ocean, although some distance from the central line, has a duration of 3 minutes 42 seconds, with an altitude of 78 deg. The eclipse occurs here at noon. (3) The western coast of Australia is impossible, on account of lack of communications, but eastern Australia is favorable. Cunnamulla, in the interior, is accessible by railway. With a duration of 3 minutes 45 seconds and an altitude of 26 deg. good work might be done here.

## Automobile

**Fit Piston Rings to Cylinders.**—The practice in many repair shops is to fit the rings to the pistons, but not to the walls of the cylinders, with the result that space is left between the ring and the cylinder wall through which the compression leaks. The object of fitting rings in this manner is to save time and trust to luck that the rings through wear will eventually conform to the walls of the cylinder. A ring that is fitted correctly conforms to the cylinder wall as soon as it is put in. Such a ring should be lapped in with fine carborundum and oil, grinding it to a fit with the cylinder wall of the cylinder in which it is to be used.

**A New Type of Windshield Cleaner** recently put on the market is a chemically treated cloth which is wiped over the glass, after the latter has got wet. The result is to break up completely the tendency of the water to stand in drops on the glass or run over it in streams, and since it is this formation that impairs vision, the cloth is decidedly effective. The water, after application of the cloth, stands in a uniform thin and altogether transparent film over the surface of the glass—a film so thin that there is no appreciable refraction and vision through it is excellent. The manufacturer states that one application of the cloth is enough for 24 hours of wet weather, but this statement we have had no opportunity to check up.

**Clear Out Cooling System in the Spring.**—To give a thorough cleansing to the cooling system, disconnect the short section of hose between bottom of the radiator and pump, connect the garage hose to the water pump and a longer section of hose to the bottom pipe of the radiator and lead it outside of the truck. Plug the overflow tube with a cork or rubber stopper. Turn on the water after starting the engine and it should be pumped through the water jacket and radiation till it runs clear. If the radiator and water jacket of the engine are found to contain considerable scale or rust, it may be necessary to flush the system out with a solution of hot water and washing soda and it may even be desirable to allow the washing soda solution to remain in the water system over night to make sure the scale is loosened.

**Trucks Save Farms from Flood.**—The value of a motor truck in an emergency was never better illustrated than on April 26, when floods threatened to destroy the levee protecting the Spring Lake farming district. It was necessary to secure 25,000 cement sacks to be filled with sand and earth to protect the crumbling embankment. These sacks were located in various sections of Central Illinois and a fleet of motor trucks was utilized for the purpose of collecting them. One of these owned in, and starting from, Bloomington, made the run with 3,000 sacks, weighing 2 tons, from Bloomington to Manito, 60 miles in 3 hours and 10 minutes, moving over poor roads, rough in many places and interspersed with mud holes. This performance demonstrates that with decent highways and motor truck equipment the United States could be made immune from serious effect upon business due to railroad strikes and greatly increase its ability for defense in event of a foreign invasion.

**Small Fields Are Expensive.** — On a number of Missouri farms that have been keeping complete cost account records, in coöperation with the University of Missouri College of Agriculture, an average of the labor required for different size fields of corn shows that the 35-acre fields average 46.6 per cent more economical of man labor and 31.4 per cent more economical of horse labor than the smallest fields of three acres each. The average amount of labor required per acre for the different size fields was:

| Average size of fields | Yield in bushels | Man hours | Horse hours |
|---|---|---|---|
| 3 Acres | 32 | 31 | 51 |
| 8½ Acres | 30 | 25 | 45 |
| 12 Acres | 30 | 25 | 43 |
| 18 Acres | 33 | 23 | 39 |
| 23 Acres | 29 | 16 | 33 |
| 34 Acres | 26 | 17 | 35 |

These figures are for average size horse-drawn machinery. The tractor capable of drawing the larger horse-drawn machinery would emphasize still more the economy of the larger fields.

# Making the Hetch-Hetchy Dam Itself

## How California's Big Water Development Is Carried On with Its Own Water

By J. F. Springer

LARGE engineering works often involve subsidiary constructions of considerable size whose primary function is merely to promote the main operations. Thus, in the great Hetch-Hetchy enterprise, which is ultimately to supply San Francisco with 400,000,000 gallons of water per day or whatever part of this immense amount will be needed, it has become advisable not only to build motor truck roads but to construct a standard gage railroad 68 miles long. Another large subsidiary undertaking is the power station which is to supply electric energy for the operation of power-driven appliances which are to be engaged upon the construction of the great Hetch-Hetchy Dam, one of the main features of the whole enterprise, and of an 18-mile tunnel of the main aqueduct.

The power development is for construction purposes—at least primarily. The water for it comes from the beautiful Lake Eleanor whose outlet has been dammed by a multiple arch dam and whose area and impounding capacity have been thus increased. Lake Eleanor is at a considerably higher elevation than the power house and the difference in level is by no means all used in providing the hydrostatic head back of the pressure water entering the turbines. The bed of the Eleanor Creek at the site of the dam is 2,347 feet higher up in the mountains than is the power station. The water rushes down Eleanor Creek and into the Cherry River. At a point on this stream some 3½ miles from the power house, a dam has been constructed whose function it is to divert sufficient water from Cherry River to operate the turbines. This diversion dam diverts the water into a channel or conduit. From this the water flows into a steel penstock which runs down a steep incline. The capacity of the canal is 200 second-feet. This part of the construction is by no means uniform. One mile is of canal lined with concrete; one mile of the total is devoted to five tunnels; and 1½ miles in all to three flumes. While the canal is lined, the tunnels are not, except at portals and a few scattering locations. The construction of the tunnels has proven pretty hard work, as the rock formation is of granite. However, rock spoil derived from the tunnels was found useful as coarse aggregate for concrete work. The flumes were constructed of wood. The minimum section is 5 x 6½ feet. Ultimately, this temporary construction is to be replaced by rock tunnels. The concreted canal and Lake Eleanor Dam are to be retained as permanent parts of the general work.

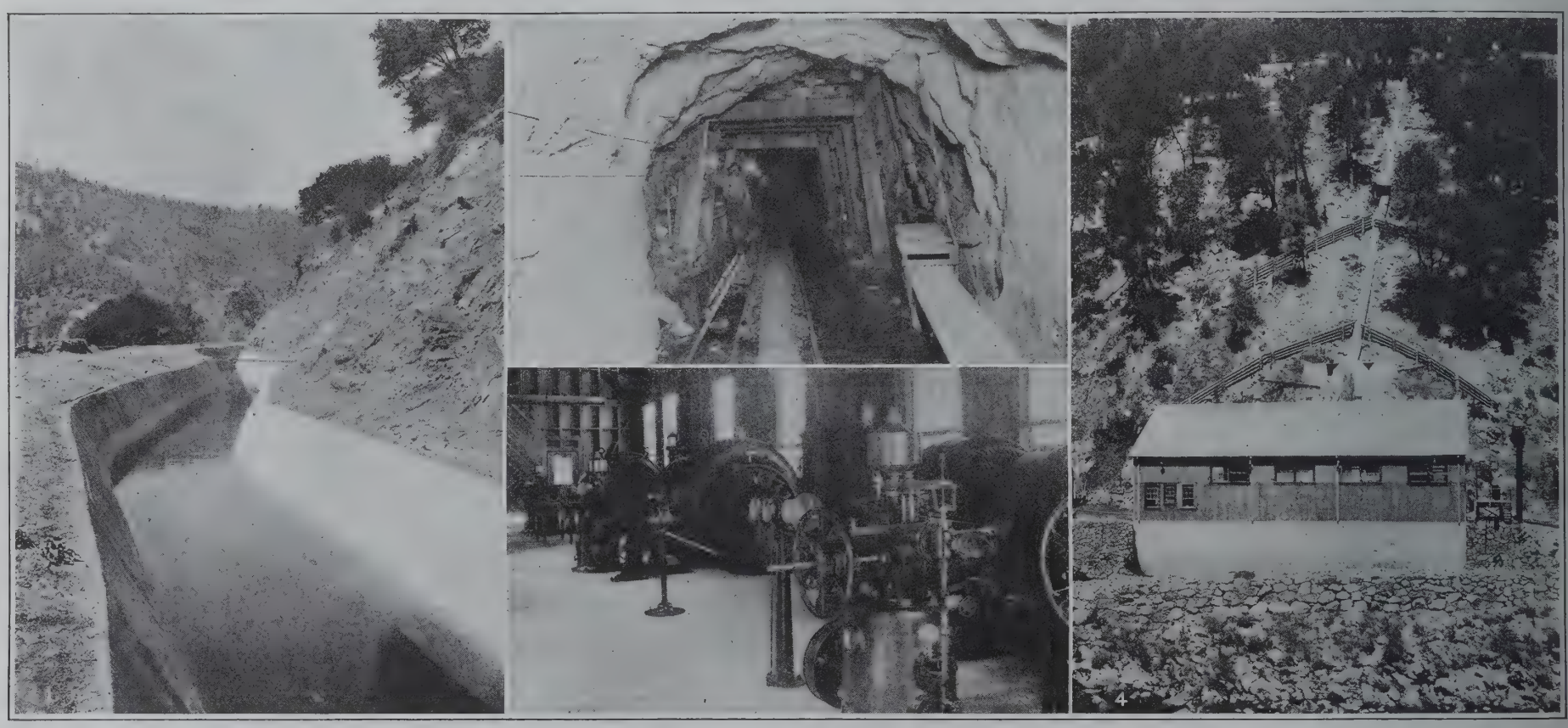
The power house is 12 miles distant from the site of Hetch-Hetchy Dam. Naturally, this dam is the means of impounding the water of Hetch-Hetchy Reservoir. This dam and reservoir are also, like Eleanor Dam and Lake, farther up in the mountains than the power development under consideration. The great dam is, however, at an elevation considerably lower than the smaller one. Hetch-Hetchy Reservoir will discharge its waste into the Tuolumne River. The water for San Francisco will, however, be delivered to a tunnel which will, for a considerable distance, carry the supply down along a line roughly parallel to the Tuolumne River on one side and the Hetch-Hetchy Railroad on the other. This tunnel will be 12 miles in length and will deliver its water to a great power house. After passing through this station, the water will enter a long stretch of tunnel. Whenever the water from Lake Eleanor is to be sent on to San Francisco, it will naturally be passed into this long tunnel as well as that from Hetch-Hetchy Reservoir. This tunnel will be 18 miles long and will extend from Early Intake, near both the power houses already mentioned, to Priest Regulating Reservoir. The Cherry River power station supplies current for construction purposes on this great tunnel. There are two large pieces of work which this power house is to care for, one being the tunnel and the other the great dam. Its location is well adapted to serve both. The most distant point of the tunnel will be at its lower end some 18 miles away in the direction of San Francisco. The big dam is 12 miles distant in the opposite direction.

The tunnel to Priest may be divided into two sections. The one nearer Early Intake is perhaps 6 miles long and has a great mass of rock overhead. The other section is some 12 miles long and is farther down the line. It is also covered with a great mass of rock. The point of junction, however, where the one terminates and the other begins is in the bottom of a big ravine where the south fork of the Tuolumne River cuts across the line of the aqueduct. The entire 18 miles of tunnel may be viewed as a single section of downgrade of unvarying inclination. The tunnel diameter is 10¼ feet and the difference in level between terminal portals is 150 feet. The capacity of this tunnel is necessarily, at least equal in amount to the contemplated delivery at San Francisco. There are in all four portals, two being intermediate. The Hetch-Hetchy Railroad touches practically all of them. This is important in the matter of prosecuting construction.

The portal at Early Intake is far below the level of the railroad; so that all the material delivered here has to be lowered. This is accomplished by means of an inclined tramway 3,800 feet long. An electric hoist is located at the upper terminus and supplies the power for operation. The steepness of parts of the incline may be judged by the fact that the grades run up to 78°. There is also another tramway at the portal 18 miles farther down the line at Priest. This is a counterbalanced affair and is used to lower supplies from the railroad. Construction plants have been set up at the termini, at the crossing of South Fork and at two shafts in intermediate locations. Standard mining equipment has been given the preference when providing these plants, one object being to reduce the cost of repairs and the amount of spare parts that would need to be carried in stock. Among the appliances in use are motor-driven air compressors, rotary blowers, storage battery locomotives, side-dump tunnel cars provided with roller bearings, rock drills, etc. A mucking machine has been in satisfactory use in the tunnel heading from the Priest portal. This machine secures the spoil from the blasting operations at the heading, elevates it and delivers to tunnel cars. The use of a machine for this work in a considerable tunnel in hard rock is understood to be rated as more or less experimental. It is thought, however, to have been advantageous here in view of the shortage of labor.

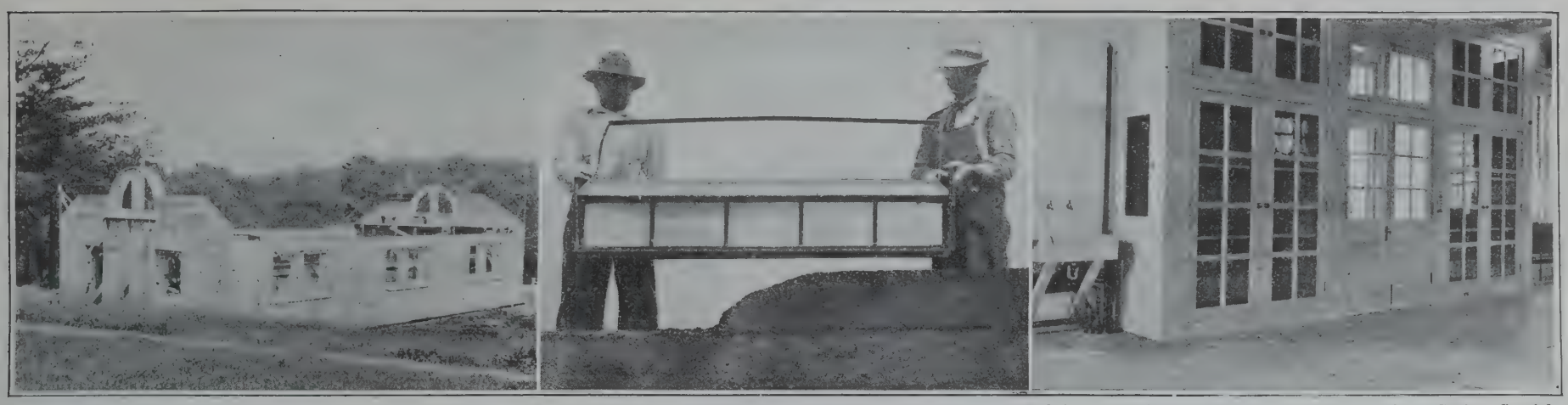
At the two shafts, there are naturally two headings per shaft. Duplicate equipment was supplied in order to permit rapid work on both. One of the shafts is known as Big Creek shaft. Before 1919 had closed, this shaft had been carried down to its full depth of 646 feet and chambers at and below tunnel grade had been excavated at its foot. These chambers were starting points for the headings. A rather unusual method of handling the water was employed on this shaft. When the excavation had got down nearly half way, a considerable flow of water entered the shaft; but lower down the flow moderated. A method usual in shaft sinking proceeds by arranging a sump in the bottom of the excavation and pumping the water up from this level. Here, this would have meant, when the shaft had reached its full depth, the hoisting of a large part of the water from twice the depth at which it entered the excavation. At the depth of 330 feet a pumping station with sump was constructed and all water from upper levels intercepted and pumped out.

(*Continued on page 437*)



1. View of the aqueduct at Early Intake. 2. Interior of the South Fork Tunnel. 3. Power house at Early Intake. 4. The timber flume that brings the water to the power house

**Some of the work in connection with the subsidiary construction of power houses on the Hetch-Hetchy project**



*Left:* General view of the experimental laboratory building recently constructed in Washington, D. C., for the Department of Research in Terrestrial Magnetism, Carnegie Institution. *Center:* Special mould employed in forming the walls of the building. *Right:* Double doors used in interior of laboratory building and some of the non-magnetic piping

**Details of the non-magnetic experimental laboratory building constructed at Washington, D. C., for research in terrestrial magnetism**

## Piloting the Ship with the Ears

**By George Gaulois**

THE day is not far distant when sailors will no longer fear fog and the darkness of the night. It will no longer be necessary to lose much valuable time at the entrance to a harbor, waiting for favorable conditions as is the case with our present method of piloting ships. The radio cable, developed during the world war for guiding friendly ships through thick mine fields and through narrow waterways at night, has been found to mean more in peace time than it could ever mean in military operations. This device, which is now being introduced in several leading countries, is almost certain to reduce the dangers of fog and darkness to a minimum.

Briefly, the principle of the radio cable, as it is called, is to employ a cable through which flows a 500-cycle alternating current. Ships intending to use the cable while passing in and out of waterways are provided with a pair of coils which intercept the electromagnetic waves emanating from the cable. By noting the relative strength of the waves reaching each coil, it is possible for the ship's navigator to determine when he is approaching the cable, on which side it is, and, with the sound in the head 'phones equal for both coils, when he is riding astride the cable. Once astride, it is relatively easy to follow it along and thus steer a correct course. In certain installations two cables are laid, each either carrying a current of different frequency so as to cause a difference in the tone of the signals, of the same frequency but with certain interruptions of a fixed kind so as to represent readily identified signals. In either event the navigator can determine which is the outgoing and which is the incoming cable, and in that manner select the proper one and thus avoid the danger of collision with a vessel coming in the opposite direction.

On October 6th last the United States Navy conducted an interesting public test of the sixteen-mile radio cable laid from near the Ambrose Channel Lightship to Fort Lafayette in the Narrows, or in the main waterway approaching the port of New York. With his pilot windows covered with heavy canvas, as shown in one of the accompanying illustrations, Commander Norton of the destroyer "Semmes" piloted his vessel along without a mishap or a single hesitation. He picked up the cable and guided the "Semmes" by "listening in" and steering to port or starboard as the volume of sound indicated his position.

It was the good fortune of the SCIENTIFIC AMERICAN to obtain details of the radio cable installation in New York Harbor some time before the present test. Indeed, complete details of this novel installation are to be found on page 195 of the August 28, 1920, issue. Readers who missed that number are referred to it for a complete drawing of the cable and the technical details.

In the case of the "Semmes" the installation consisted of two large receiving coils mounted above the water line on either side of the steel hull. These coils, it will be noted from another one of the accompanying illustrations, resemble nothing so much as large but empty black frames. These coils are each connected with a two-stage vacuum-tube amplifier, which amplifies the weak currents induced in the coils by the electromagnetic waves emanating from the radio cable, some four hundred times. The current, being of an audible frequency, is led directly to a pair of head 'phones. In the case of this test the cable current was interrupted so as to spell "N A V Y" in the usual telegraph code, and these signals registered in the head 'phones in the form of soft but positive clicks. A simple switch makes it possible for the navigator to listen in on either coil and so determine the relative force of the electromagnetic waves reaching each coil.

It is interesting to note that the radio cable has been developed by Earl C. Hanson, a young Californian, whose radio work dates back to the early days of amateur wireless on the Pacific coast.

## Rust Preventives

WHENEVER machinery is shipped or stored the prevention of rust upon polished surfaces is a problem. It has been an attractive problem to chemists and the market now affords several compounds designed to protect the metal surface, to cling tenaciously to it and yet be easily removed under certain conditions. One of the compounds not only prevents the formation of new oxide or rust, but makes preliminary cleaning unnecessary, takes care of any moisture that may be present upon the surface, and is even said to remove any traces of preliminary rust which may be present when the compound is applied.

## A Magnetic-Proof House for the Workers

**By Harry A. Mount**

A BUILDING of unique construction, in which not an ounce of steel or iron is used, has recently been completed in Washington for use as an experimental laboratory for the Department of Research in Terrestrial Magnetism, Carnegie Institution.

The outer walls are of double concrete construction, with 2½ inches of dead air space between. The reinforcement is brass rods, tied together with brass tie wires.

The building requirements for the research work contemplated were (*a*) unusual rigidity and strength, (*b*) non-magnetic construction, and (*c*) insulation against sudden external temperature changes.

After careful consideration the double-wall monolithic construction was adopted. The walls were built up with a Van Guilder machine. This consists of four steel plates held parallel with proper braces. The walls are built up tier by tier, a rather dry mixture of concrete being tamped in the mold, and the machine being moved on along the wall without waiting for the concrete to dry. A stucco finish is placed directly on the outside wall when completed and plaster is placed directly on the inside wall. The sill courses about the building and under the windows and the columns at the entrance of the building are of artificial stone with a fine granite and mica surface, and were all cast in place with the walls.

Further insulation against sudden temperature changes is provided by double windows and double doors and by a double ceiling of plaster-board, enclosing a dead air space of 10 inches between.

Because of the unusual requirements and specifications, particularly those for non-magnetic construction, it was not possible to secure a contract for the work, which had, therefore, to be undertaken by the Department. It was impossible, even, to secure bids for the special mill-work required, all of which had to be done in their own shop. The cost of construction, despite the increased expense necessary, was about 30 cents per cubic foot of volume enclosed, comparing very favorably with prevailing rates for ordinary lumber construction.

The equipment of the building, other than the special

(*Continued on page 438*)

*Left:* Navigating bridge of the U. S. S. "Semmes," showing the heavy canvas screens which shut off the view of the navigating officer during the radio cable test. *Center:* Radio cable receiving set aboard the "Semmes," with two two-stage amplifiers, sensitive electric meters, switch for connecting to either coil, and pair of head 'phones very much in evidence. *Right:* One of the coils mounted on one side of the steel hull

**Views of the first test of the radio cable installed in the approach to the port of New York**

# The Romance of Invention—XVIII

## William Leroy Emmet—Inventor, Engineer and Builder of Power Plants

By C. H. Claudy

AMONG the eclipsed luminaries of invention, the men so much less well known to the general public than to the technical world and particularly the engineering world, is William Leroy Emmet, of the blood of Robert Emmet, and of the staff of the General Electric Company, for whom he is a consulting engineer. In the shops of that organization Mr. Emmet has done much important work, notably in the development of the mighty turbine-manufacturing industry (the tale of that Curtiss turbine has been told in this series) and the electric drive for ships, primarily battleships, but lately for merchant ships.

Of these accomplishments more in a moment. But perhaps the greatest of all is one still in process of testing, but which its deviser and builder believes will work an enormous change, not to say a revolution in steam plants throughout all industry. This is the mercury-vapor boiler and engine. Let it be said at the outset that Mr. Emmet is extremely particular that he neither claim nor be given more credit for the development of this apparatus than he deserves. He is careful to state that others besides himself have worked upon binary vapor power plants, and that the fundamental idea of this one came to him from Bradley, himself a famous inventor. He also wants it made plain that no one in the great Schenectady plants carries a conception through to execution unaided. He has competent assistants, materials, opportunities, and so must give to the organization, as well as to the help of individuals, the credit which is due.

steam runs a steam turbine. In this condition (without the mercury turbine) the whole outfit would operate much as does an ordinary boiler and turbine, with such slight losses of heat as might be occasioned by the use of a mercury boiler and condenser instead of the ordinary steam boiler for the production of steam.

Putting the mercury-vapor turbine into the system decreases the efficiency of the whole, considered as a steam-making plant, very little, and extracts from the mercury vapor, before it is used, power to heat water to make steam from which more power is extracted. The net result is that, used in connected with such a furnace as normally is required to produce two thousand horse-power from a steam plant, the combination should produce 3,200. The mercury turbine gives 1,560 horse-power, of which 1,200 is clear gain.

The problems solved in the development of this apparatus are much too numerous and difficult even to be catalogued. Perhaps the first and most vital was the question of leakage. Mercury is both heavy and expensive and its vapor is poisonous. It is essential that throughout the system no vapor of mercury leak out, if the air about it is to be kept non-toxic. It is also essential that as little loss as possible be permitted, because with mercury at a dollar a pound and a pound being less than two cubic inches in extent, any considerable leakage would be disastrously expensive.

The cure for leakage is twofold. First, the whole system is so designed that every joint, from boiler to pipe, from pipe to turbine, from turbine to condenser

room at the power plant at Schenectady for some time, and while in many ways an experimental structure, it has demonstrated that the problems in connection with its construction and operation have been solved. Exteriorly it appears much as any steam boiler outfit with some odd looking pipes, boxes and excrescences above. Interiorly it would present a difficult problem even to an experienced steam engineer; Mr. Emmet stated that he doubted much whether even a competent power man could take it to pieces and explain the reason for its construction if he had not the key in the words "mercury vapor."

A great power company in a New England city has examined the Schenectady machine and ordered one for its own use. This is now in process of manufacture, and should be in place and operation within a year. It is obvious that if one power company gets hold of a power-developing unit which will show a thermal efficiency equal to that of the Deisel engine, while still using coal, it will not be long before others follow suit.

Mr. Emmet, who has a strong dislike for the word "prophecy" as far as he and his work is concerned, believes that there is a future for this idea not only in huge sizes but in small plants. "I see no reason why it cannot be operated efficiently for automobile trucks and even pleasure cars," he said. "I think the day will arrive when steam locomotives are equipped in this way. Any system which will save nearly half the coal used is of tremendous importance not only in saving money, but in saving the transportation of

*THERE are certain scientists, inventors, discoverers, pioneers, the very nature of whose work makes them well and widely known—the Edisons, the Wrights, the Marconis. There are others, doing just as important work, the nature of which is such that the general public hears of them but little, their renown being confined to narrower circles of engineering, philosophical or scientific societies and associations. The man in the street who could name the inventor of the "grasshopper" cut-off gear used on all modern locomotives, or recall the name of the discoverer of the moon of Mars, or explain the genesis of the long series of experiments and discoveries which made the modern electric light out of that feeble glowing bulb which first startled the world so many years ago, would be well informed indeed. It is the story of one of these great inventors of little general repute that Mr. Claudy tells us in this account of Mr. Emmett, who would doubtless prefer to be known as inventor of the mercury-vapor turbine.*—THE EDITOR.

**William L. Emmett, inventor of the mercury-vapor power plant, and the first Curtiss vertical turbine, in the development of which he played a prominent part**

But with this out of the way, it is nevertheless true that the mercury-vapor turbine, as applied to power production in connection with steam plants, is Mr. Emmet's personal contribution to applied engineering which may well rank high above either the electric drive or the development of the Curtiss turbine, the latter a contribution to the family of prime movers which practically put the reciprocating engine for electric generation out of business. Put in as brief and simple a form as possible, the mercury vapor plant is one which increases the possible efficiency of the whole from the maximum of twenty per cent, representing the best we can do in extracting energy from coal and delivering it in the form of mechanical power, to thirty-five per cent and possibly more.

In its elemental form the working of this idea may be thus described. Heat is taken from coal and made to vaporize mercury. The mercury vapor is made to rotate a turbine, in which process it makes some, but not all the heat-energy available as mechanical power. The mercury vapor is then condensed into mercury and used over and over again. In the process of condensation from mercury vapor, at a temperature of eight hundred degrees, to mercury in the liquid form, the heat is extracted from the vapor and made to produce steam in the water in the condensing system. This steam is used to turn the turbine of an ordinary steam plant.

If the mercury-vapor turbine were eliminated from the system what would be left would be a source of heat, a mercury boiler, a condenser extracting the heat from the mercury vapor and producing steam, which

and back again, is a welded joint—a "jointless" joint in other words—through which neither vapor from within nor air from without can leak because there is no place for it to leak through. Second is the provision of piped containers fitted over all places where leakage *might* occur, such as the end of the turbine shaft, and the keeping of a vacuum suction always in this container, drawing off and returning to the system any vapor of mercury which might get out.

There are engineering advantages in a system of this kind quite outside of the power-gain from a given number of pounds of coal. There is no scale to worry the steam producer, in a mercury boiler, since the mercury does not oxydize under the conditions in which it is used. The mercury vapor has no effect upon the boiler so that element of the outfit is practically indestructible. A relatively small quantity of mercury is made to serve for a large one by the rapidity of the cycle. In a design now proposed about 30,000 pounds of mercury will be used and about 230,000 pounds vaporized per hour at full load. Later designs may need a much smaller quantity of mercury in the boiler. The mercury runs in a complete cycle of liquid, vapor, turbine, condenser, liquid, almost seven times in an hour. The plant may be used for the generation of steam alone by the operation of a by-pass, cutting off the mercury vapor from its turbine and making of it merely a means of conveying heat from fire to water.

This engine, mercury-vapor boiler and steam system, be it understood, is not a theory but a fact. A complete installation has been running in the huge boiler

fuel. It may be possible to produce by this method airplane engines with weights of less than three pounds per horse-power developed, and of very high economy."

The electric drive for battleships, which is so rapidly displacing other forms of machinery designed to deliver power to the propeller has been developed at Schenectady under the personal supervision of Mr. Emmet. Lately the question has arisen as to its availability for hulls other than fighting ones, and its designer now believes that electric drive for merchant ships will be increasingly demanded and used. For a time the success which attended the operation of geared turbines interrupted the current of thought which tended to develop the electric drive for large commercial vessels, but recent improvements in electrical designs and operation of such power plants, with a very high degree of superheat, have again turned attention to this form of propulsion as perhaps the most economical method, particularly for large hulls and long runs.

The advantages are many, as stated by Mr. Emmet, and include a saving in space, which is of tremendous importance in the operation of vessels which must carry fuel not only for the outward but the return run. In such case fuel is being carried for half the distance traveled at cargo rates. Under such circumstances, the fact becomes of acute importance that the more space is occupied by propelling machinery, the less is the earning power of the vessel. There is no room for argument regarding the saving of space in an electric drive over the geared turbine. In a typical example Mr. Em-

(*Continued on page 438*)

# Painted Coffee

## A Trick of the Trade That Is Little Known Outside Brazil

By Robert C. Brown

WHAT has the paint or chemical manufacturer got to do with the coffee industry? Nothing at all; ninety-nine people out of a hundred will speak right up, and some will shout out of their turn in order to be heard, to inform you that it is preposterous to associate manufacturers of paints and chemicals with the raisers of coffee who have invested hundreds of thousands of dollars in their plantations. Some may go on and give you facts and figures about coffee, which is rapidly becoming the universal morning and after-dinner beverage. They will even tell you that coffee grows only in certain countries and that the best coffee comes from here or there and that Brazil is the greatest producing country in the world of this delicious little bean.

While the manufacturers mentioned above really hold nothing in common with the plantation raiser, they are friends, though indirectly, with Brazilian shippers of coffee. And when you mention such a fact to your friends they will immediately laugh and advise you to see a doctor for an examination of the little gray matter you have, commonly known as brains. But stick to your point, and ask if they have ever seen or drunk coffee that has been painted, then the laughter will be renewed and in all probability it will be louder and longer than before. Wait until the hilarity has subsided before launching your big guns broadside and watch your listeners sit up and take notice.

Yes, there is such a thing as painted coffee. And the painting is done right in Rio de Janeiro, the only city in the world where coffee is painted before being shipped to certain ports in this present topsy-turvy revolving globe. And not only is coffee painted, but it is also washed. Coffee is painted black, blue, green and yellow and is also bleached in some cases to give the desired hue required by the buyer. Then there is also such a thing as polished coffee.

Painted, polished or bleached coffee is not shipped to all parts of the globe for the simple reason the health authorities of some countries have had laws passed to prevent its entrance. Today the majority of this kind of coffee is shipped either to the northern ports of Brazil or to South Africa. Chile still buys some coffee after it has been treated. It is not so many years ago when painted and polished coffee was shipped to the ports in the United States as well as to Europe.

When some of the local shippers of coffee receive orders for painted coffee, the polishing or painting plants are immediately made ready for the operation. Whether the coffee was grown in the State of Rio de Janeiro, Sao Paulo, or Espirito Santo, the work is done here. The coffee in its natural state is given to one of the six firms in this city which does such work, with special machinery. To paint or polish coffee it is necessary to dump it into cylinders which are equipped with batting paddles. Each cylinder holds 702 pounds of coffee. The man in charge of the cylinders drops in the coloring or polishing material needed to give the desired finish. In painting or polishing, the material is applied a tablespoonful at a time until proper results are obtained. The batting paddles which revolve at a high rate of speed do the rest of the work.

Some coffee sold to South Africa after it has been treated has a bluish green luster to make it look like Central American or Porto Rico coffee. Some buyers in South Africa prefer their coffee to imitate Java coffee, which is yellow, and their wishes are gratified with the aid of coloring and machinery. In making black coffee for the northern ports of Brazil, graphite is used to help solve the problem. Others prefer what is known as white, but after treatment it shows up more as a cream color.

Painting or polishing cylinders hold six bags and it generally takes about twenty minutes for each operation, so working at top speed each machine can turn out approximately eighteen bags of coffee in an hour's time. After the coffee has been treated a trap door on the side of the cylinder is opened and the coffee is run into bags. After sixty kilos have been deposited in each bag, it is sewed up and final preparations are made for shipment.

The ingredients used in painting or polishing coffee are powdered aluminum, graphite, powdered paints blue and green, carnauba wax, talcum powder and ochre—the latter produces a vegetable paint.

It is only the natural coffee that is treated. On arrival at its destination and before it is sold for domestic consumption the coffee is roasted. In the latter operation the beans lose the effect of their treatment in Rio. The material used in no way affects the coffee and the majority of people could not tell by the taste that the beans had been treated.

Painted or polished coffee is a business in itself. If any one firm or individual handled this kind of coffee alone a nice profit would be made on a year's business. About 300,000 bags of this style are shipped annually to South Africa. Coffee is also washed before shipping and the process of washing is held by some as a trade secret.

Two American firms ship coffee of this type and have their own machinery for the work. In addition to this equipment one company has several separating machines to separate the different sizes and types of coffee as well as two blowers attached to the same machine to take out any sticks, dust and broken beans. In its plant there are also two mixing machines with a capacity of 11,000 bags to make one lot of the same quality of coffee, as well as two automatic weighing machines, which insure the buyer that each bag held sixty kilos when originally shipped.

When or in what city the coffee painting and polishing process came into use is not exactly known, but it is said the Germans were the first to employ such methods. It is said the coffee buyers from German houses bought coffee in the various coffee growing countries and it was then shipped to Germany for treatment. After being treated and made to look like Java, Central American or Porto Rico coffee it was re-exported to different countries where such coffee was required.

When the war broke out this industry, like many others, was lost to the Germans. There was still a demand for painted coffee and the buyers turned to the coffee shippers of this city. Here their demands were met and today Rio de Janeiro has the distinction of being the only coffee-planting city in the world, and the second greatest coffee-shipping port in the universe, bowing only to Santos.

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### An Appeal

To the Editor of the SCIENTIFIC AMERICAN:

The American Meteorological Society has learned that the staff of the Zentralanstalt für Meteorologie, the national weather service of Austria, numbering with their families 67 persons, are in urgent need of food and other bare necessities of life. This establishment has always taken a conspicuous part in the development of meteorology and geophysics, under the successive directorship of such eminent scientists as Kreil, Jelinek, Hann, Pernter, Trabert and Exner, and the tragic situation of the Austrian meteorologists appeals strongly to the sympathy of their colleagues in this country. Those who desire to render aid in this emergency can send food drafts direct to Dr. Moritz Topolansky, secretary of the Zentralanstalt für Meteorologie und Geodynamik, Hohe Warte 38, Vienna XIX, or through the secretary of the American Meteorological Society, Dr. C. F. Brooks, Weather Bureau, Washington, D. C.

Washington, D. C. C. FITZHUGH TALMAN.

### Again the Tractor vs. the Horse

To the Editor of the SCIENTIFIC AMERICAN:

In your department "The Motor-Driven Commercial Vehicle," I note in an article under the date of September 18th, entitled "Horses Displaced by Tractors," the following statement: "The number of horses displaced by tractors in the corn belt is largely determined by the number it is necessary to keep for corn cultivation and other work current at the same time which the tractor cannot do."

If this is the condition of power farming in the corn belt I am greatly surprised that they are so far behind the younger agricultural district of the Southwest.

The writer is farming about 250 acres of which 25 acres is in alfalfa and the balance Puna long staple cotton. Previous to motorizing the ranch it was necessary to use fifteen head of horses and mules; at present we would not need to keep a single horse were it not for the fact that it is not advisable to use tractors on the very bad road from the ranch to the gin and even this problem would be better handled by a sturdy truck and two or three trailers than by horses.

We have one four-plow tractor of the caterpillar or crawler type and two six-cylinder, two-row motor cultivators. With the big engine we do all plowing and disking and such heavy work as moving the hay derrick, etc. The motor cultivators which can be equipped with draw bar and converted into light handy tractors in about an hour's work, or equipped with pulley for light belt work, will cut the cotton stalks, pull the harrow or drag, plant, cultivate more efficiently than horse-drawn machinery and handle mower, side delivery rake, loader and even the stacker fork, and do any odd jobs of hauling, grading, etc.

In planting the big engine will go ahead with ten-foot tandem disk and spike harrow, followed by one cultivator with drag and the other with two-row planter. In this way three men can easily plant from twenty to thirty acres a day. As to cultivators it is hard to estimate their superiority over a horse cultivator as each machine will cover about twenty acres daily; they break down far less of the plants in turning; never tire in tearing out grass and what is the greatest advantage in this hot country, will put in a full day's work in temperatures over 100 degrees where stock can hardly accomplish more than four or five hours. Also by reason of high arch construction they can keep on cultivating about two weeks after the horse-driven tools have been stopped and the crop laid by.

We employed two ordinary negro farm hands of no tractor experience to handle the machines, the writer making all adjustments and repairs. As to economy, two men did more and better work than could be accomplished with five men and ten head of stock. The fuel consumption is about 1¼ gallons of gasoline per hour and a quart of oil daily. The power plant gave practically perfect service, the only repairs being in the driving and cultivator parts. The cost is about the price of four good mules harnessed and two single-row-horse-drawn cultivators.

In conclusion, I would state that if I were obliged to give up either part of my equipment I would prefer to use horses in the spring for plowing and disking and tractors during the hot summer for cultivating and hay harvesting, exactly the opposite from what seems, as described in your article, to be the custom in the corn belt. The day of the "Motorized Farm" is not coming, it is already here.

Winterhaven, Cal. T. B. GOODWIN.

[*We are convinced that Mr. Goodwin's experience, while doubtless characteristic to some extent of his part of the country, is not representative of the country at large, and necessitates no recession from the opinion which we expressed on this subject in our issue of May 29th. Nevertheless, we are glad to print it as an indication of the extent to which the replacement of horses may go under the most favorable conditions.* —THE EDITOR.]

### The New Science

To the Editor of the SCIENTIFIC AMERICAN:

Although psychology is now regularly being taught in our colleges, there appears to be considerable mystery about what this science really is, and how it can be applied to advantage. It has been said that the several writers in this field have discussed systems of their own, thus presupposing a lack of harmony, or agreement, as to fundamental law.

There is a saying that "In Nature the obvious is seldom true." The one who got up this phrase, undoubtedly was a master of psychology, and to all intents it is half of its definition. The other half would then merely be some expedient for disclosing the real truths. If this is so, a psychologist would indeed witness a world burdened by a myriad of fallacies.

There may be a question whether the true psychologist is born or made, even as a poet or an artist is predestined, but in the meantime, if in this confused era we could obtain from psychology its truest message, its best logic, it would quite properly be in a psychological moment. A discussion of this subject would doubtless be a very live one, and would help to bring a comparatively neglected science to the front.

New York. A. F. SHORE.

# A Mechanical Age for the Farm

## What Nebraska, Through Its State University, Is Doing to Bring It About

By R. P. Crawford

PROBABLY no better proof of the fact that the farmer today has a large part in the engineering development of this country has been afforded in recent years than the dedication last April of the agricultural engineering building of the University of Nebraska. This structure, just completed at a cost of a quarter of a million dollars, is probably the finest building of its kind in the country. Let it be said that when the architects set out to draw the plans for this structure they had no precedent to go on, because a building of this kind had not as yet found a place on an American university campus. They had been teaching civil engineering, mechanical engineering, electrical engineering, and just about everything but the branches of engineering that deal especially with agriculture. It is true some colleges gave a few shop courses, but they were usually dubbed shop work or farm mechanics and were simply offshoots of the other departments.

But today agricultural engineering represents a line of work all its own. For instance, the University of Nebraska is now engaged in a series of tractor tests, the like of which has never before been attempted in America. For it is now a state law that no tractor can be sold in the State of Nebraska until all of its advertised ratings have been actually proved in a series of tests carried on at the university and a permit issued by the State Railway Commission. Heretofore tractor manufacturers have been content to make their own tests. It is true that there have been competitive tests carried on every summer but at best these were only a few field tests. But now practically every claim of the manufacturer will be tested and his advertising must live up to the actual tests.

It is undoubtedly true that the farmers of this country are entering upon one of the greatest mechanical ages that they have ever witnessed. The growing shortage of the ordinary farm hand is doing much to make the farmer turn to mechanical appliances, and, as I write, my desk is piled with letters telling what tractors have done in the Middle West, and how they have saved the extra hired hand. It is true that not in every case have they been a success, but the last few years have witnessed a great change in sentiment among the farmers of the country. This has been due largely to the perfecting of the machines. For every really successful invention that can be offered to the farmers of the country, there will be thousands ready to give it the glad hand.

The farmer is becoming better and better educated and today farm homes throughout the Middle West have conveniences that a few years ago would have been only for the cities. A few years ago a detailed survey was made of the 142 homes in Orange township, Blackhawk County, Iowa, before the present wave of prosperity had struck the country. Fifty-six of these homes were tenant homes. The accompanying table tells what the survey showed regarding modern conveniences.

Does not this record seem surprising when one recalls that more than a third of the homes were tenant homes? Undoubtedly if this survey were to be made today, the record would be still better. Of course all of these were country homes.

Just what kind of courses, do you suppose, are taught in the agricultural engineering department of the University of Nebraska? First, of course, comes the gasoline engine with the tractor and automobile leading the way. There are courses for the junior and senior in the university who expect to make agricultural engineering a life work, there are courses for the student in the agricultural high school run in connection with the college of agriculture, and finally there are tractor and automobile courses for the farmer who can take only a few weeks off in the middle of winter to study farm mechanics. These latter courses are practically the same as those offered at dozens of automobile and tractor schools throughout our country, which charge a good fee for a few weeks' instruction. The main difference in the case of the university work is that it costs the student practically nothing.

There are courses in woodwork, where the students learn to do any woodwork around the farm, and courses in forge work. And then comes rural architecture. Do you remember some of those funny old farm houses and some of the one-room schools, every one just alike? Every student here must make some practical designs of modern farm buildings. Then there is work in designing the farmstead. I wonder if the factory efficiency men who spend so much time telling just how every machine should be placed know that the farmer has to solve just such problems himself. The other day a professor of agricultural engineering figured out that if a farmer travels fifty times a day between his house and barn and the distance is 400 feet, in the course of a year he does about the same thing as walking from Omaha to New York. By having the barn 200 feet from the house he would be able to save about thirty-five days' time that in the other case would be spent walking. In fact today in all of our better agricultural colleges, the planning of the farmstead buildings is studied with as much care as the efficiency expert plans the factory.

Every type of machinery that the farm boy comes in contact with on the home farm is studied, with practical tests in the field. In the basement of the building is a large earth plat, about 12 feet wide and 156 feet long, which provides a practical testing ground for tillage implements the year round. An electrically-driven test car operates on rails at the side of the track. The implement to be tested is hitched to this car and horsepower calculations are made with a dynamometer. This has nothing to do with the tractor testing which is carried on as a separate branch of the work.

Of course every farm is equipped with pumps so that subject must also enter into agricultural engineering. In one laboratory there are five wells, one of them being of a large size and permitting of the use of an irrigating pump. There is a weir box for measuring the flow of water. Irrigation and drainage is another branch of the work. In fact, all through the Corn Belt today one will find tile drainage systems being installed and land once thought worthless reclaimed and producing bumper crops. Irrigation engineering, the application of water to the land, and irrigation laws are taken up.

For the student who aspires to become an agricultural engineer there are courses in agricultural physics and five rooms in the new building are given over to that subject. There is also a laboratory devoted especially to handling farm grains.

The main part of the building has a frontage of 180 feet and is 76 feet deep. There is a rear wing, 84 by 140 feet, which takes care of the forge shop, the motors and automobile laboratories, ignition and carburetor laboratory, grain handling lab-

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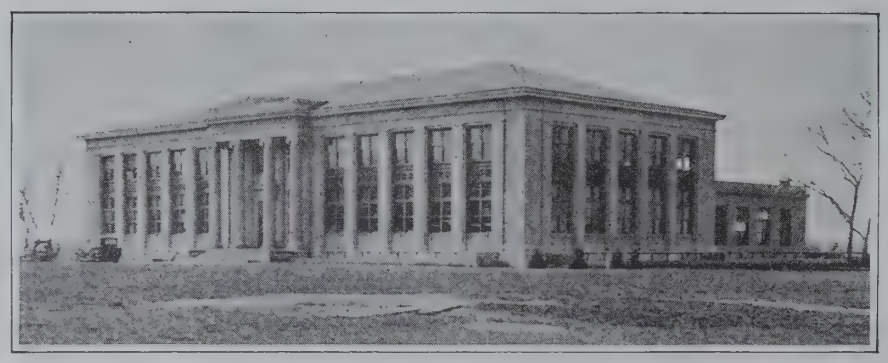


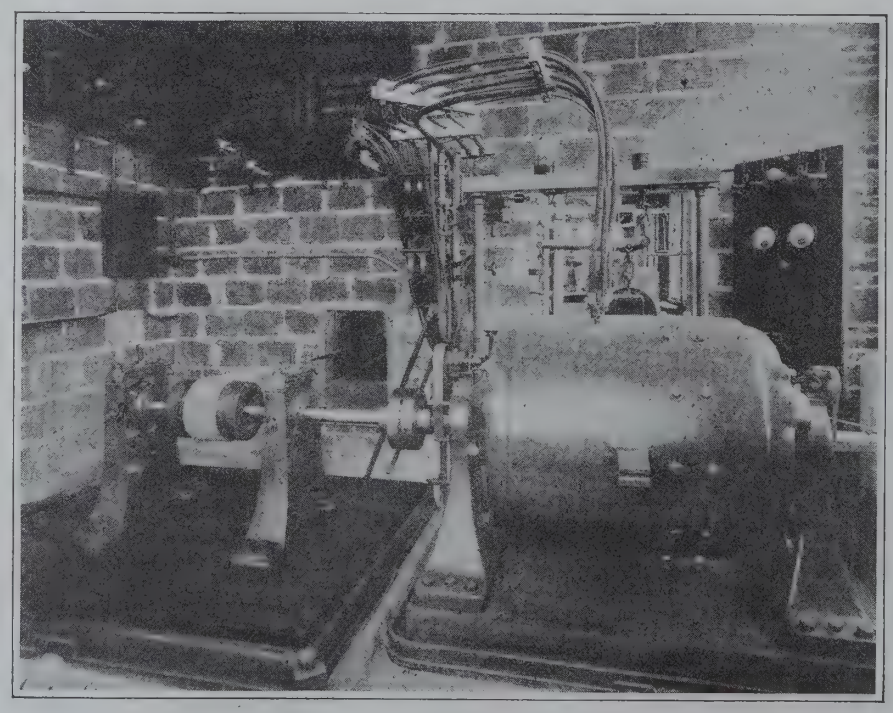
Agricultural Engineering Building at the University of Nebraska

### *Modern Farm Statistics at a Glance*

*A careful census of the 142 farms in a single Iowa township showed:*

| | |
|---|---|
| Number of homes with running water | 57 |
| Number of homes with electric lights | 16 |
| Number of homes with gas lights | 47 |
| Number of homes with power washers | 68 |
| Number of homes with vacuum cleaners | 76 |
| Number of homes with furnace, hot water or steam heat | 72 |
| Number of homes with telephones | 132 |
| Number of homes with gas cook stoves | 29 |
| Number of families having automobiles | 75 |

Dynamometer car (left) pulled by tractor (right) in a cold-weather test of the tractor



The electric dynamometer used for tests of horse-power developed on the belt

## A Machine That Cleans Sewers

IN order to keep the sewers of Salt Lake City in good working condition, a special sewer-cleaning machine has been devised that is bringing good results. It is built of structural shapes and has wheels that keep the scoop from coming in contact with the bottom of the sewer. Ropes are attached to both ends of the machine to be used if any serious obstacle is encountered in the sewer, but as a usual thing the sewage is sufficient to carry the machine through safely from one manhole to the next without the use of the rope at all. Three of these scrapers are in use, being designed for sewers ranging from 42 to 64 inches in diameter. It has been found that they bring the best results when the disk has a diameter 1¼ inches less than that of the sewer. This dimension restricts the flow past the machine to an annular space of ⅝ of an inch.

**Salt Lake City makes use of several of these machines for cleaning its sewers**

## Fuel Oil Versus Coal on French Railways

THE great scarcity of coal has caused the French railways to turn to fuel oil for operating their steam locomotives. Already the Paris, Lyon and Mediterrannée Railway Company has transformed some of its motive power from coal to fuel-oil consumption, which is about to be followed by the Chemin de Fer de l'Etat, or State-owned railway, and engines at its shops at Saintes, in La Rochelle section, are now underging changes for experimental purposes.

Much attention is being directed to the announcement that the first-named railway company is planning to equip 200 locomotives for fuel oil and install numerous storage reservoirs of from 40 to 100 tons capacity at various points on its lines.

The accompanying illustrations show a test with a Pacific type French locomotive arranged for fuel-oil firing. This locomotive made a flawless run between Paris and Tours, during which the passengers were surprised by the smoothness of operation and the absence of smoke. Among the many advantages claimed for fuel-oil operation over coal on French railways are: Less work for the fireman; ease of controlling the fire, which makes it possible to economize fuel when the locomotive is not operating at full power; simple storage of fuel; greater heating capacity for the same weight; automatic shutting off of fire in case of accident, thus eliminating the danger of conflagration in a wreck.

The first shipment of 7,000 tons of fuel-oil ordered by the General Commissioner of Petroleum has been received for distribution and the Minister of Marine has announced that he will place a large amount of oil now in stock at the disposal of the commissioner.

The general interest shown in industral circles in connection with fuel-oil replacing coal should open a large field for the American product and oil-burning appliances and devices of various kinds in France. During the war large amounts of petroleum products entered the port of La Rochelle, where an English subsidiary of an Amreican concern maintains a depot of large capacity.

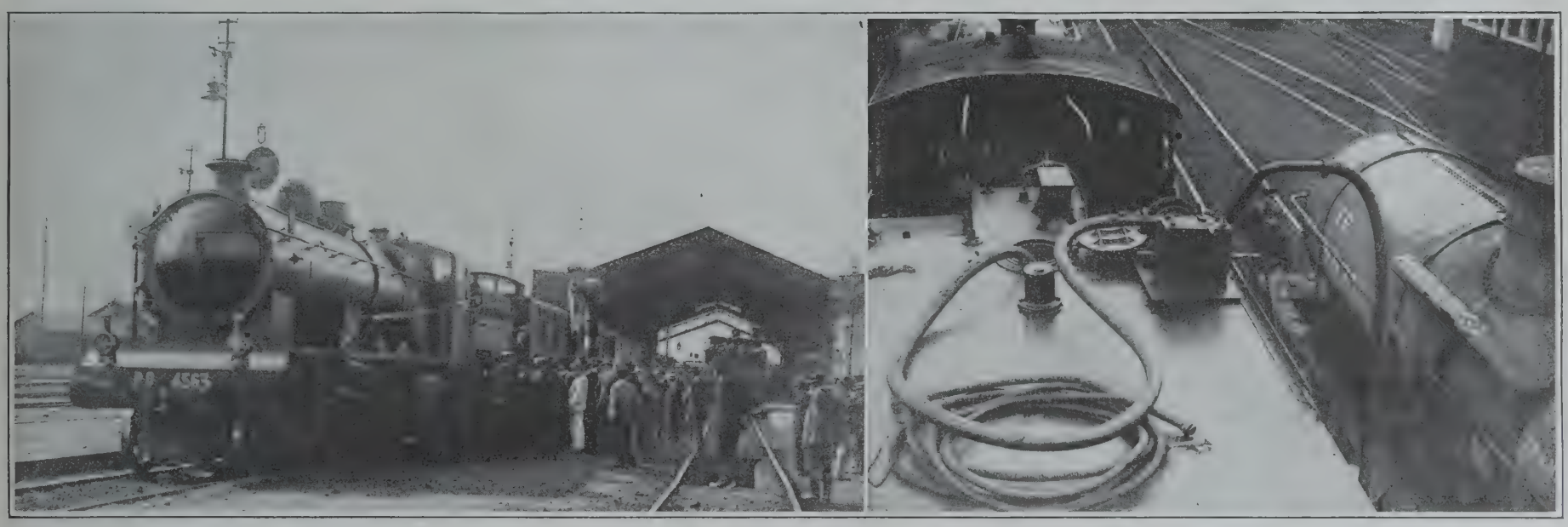
## Does Cold Kill Plants?

SOME very interesting experiments have recently been carried out to discover the effect of frost on vegetation. As is well known many plants are killed to the ground in the winter although the rootstocks which are protected by the soil live and are ready to shoot again with the coming of warmer weather. If it were simply the action of the cold that killed the plant the roots would certainly be destroyed for the ground in which they are situated is frozen solid. There is the best of reason for believing that it is not so much the cold as the excessive loss of moisture that really destroys the vegetable tissue. The upper part of the plant is subjected to a continuous evaporation and the loss of moisture cannot be made good seeing that the roots are in solidly frozen ground.

This evaporation during dry frosty weather is much greater than is commonly supposed. A chunk of ice weighing nineteen and a half pounds was hung among the branches of a small oak on February the 2nd. When the ice was taken down on the 14th of the month it was found to weigh eighteen pounds. All the time there had not been the smallest relaxation in the frost and, almost every day, the thermometer touched the zero point. Yet during this time a compact mass of ice lost nearly 8 per cent of its total weight in evaporation.

Later, on February 27th, another piece of ice was suspended from the tree, only this time it was placed in a pan so that no water should be lost in the event of mild conditions setting in. The ice and pan and the supporting wire weighed twenty-four pounds. On March the 24th, when only water was left, the entire arrangement weighed eighteen pounds. Thus, in a little less than a month, more than twenty-five per cent of the moisture had vanished through evaporation.

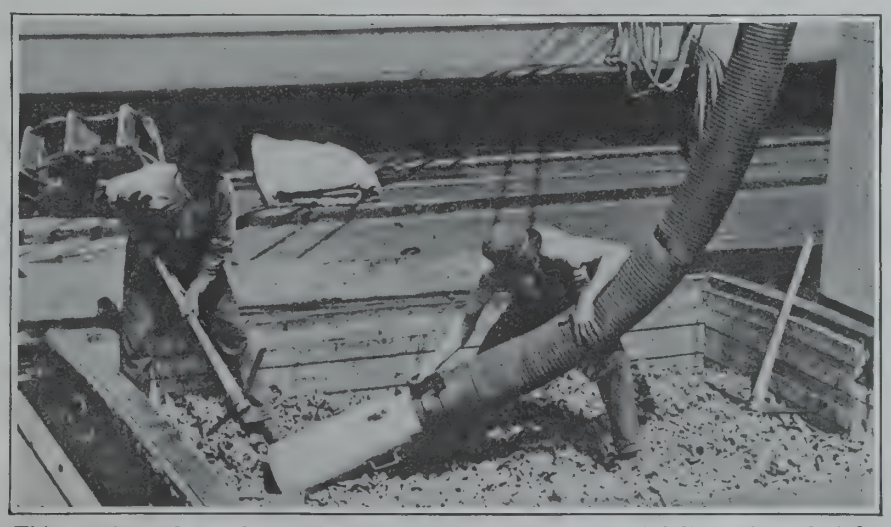
When these points are considered it will be realized that the moisture which the unprotected plant is called upon to give us is very considerable indeed. In the face of such a showing it seems altogether reasonable that the observed damage to standing vegetation in winter is a matter of evaporation. By covering the plants with soil, straw, or anything that will check evaporation, much may be done to carry the plants through the winter and this although it is not possible to keep the cold at bay.—By *S. Leonard Bastin.*



**Pacific type locomotive equipped for fuel-oil firing, and a view of the tender of the same locomotive, showing top of fuel tank and the small steam-driven pump which pumps oil from a tank car to the tender's tank**

## Carbonic Acid as a Fire Preventer

IN spite of all precautions fires frequently occur in places where large quantities of coal are stored. Under present conditions such coal fires are a source of particular danger, where so many war stores are still lying around. The German *Steam Boiler and Engine Driving Journal* now states that at a large coal dump in Dortmund the coal is now being stacked up in conjunction with the use of carbonic acid, the acid being used in the same way as is commonly employed when coaling ships. Carbonic acid is, of course, much heavier than air and thus always fills thoroughly even the lowest parts of the coal bunkers. The process is especially suitable when storing coal in high receptacles.—By *Arthur J. Keane.*



**This suction tube sucks up the copra in the ship's hold and delivers it to freight cars some distance away**

## Suction as an Unloader of Ships

THE same force which enables the housewife to suck the dust out of carpets and draperies and dusty corners is now being applied in more ways than one to simplify the work of the industrial world. One of the latest applications is to unload ships carrying copra and other similar cargoes.

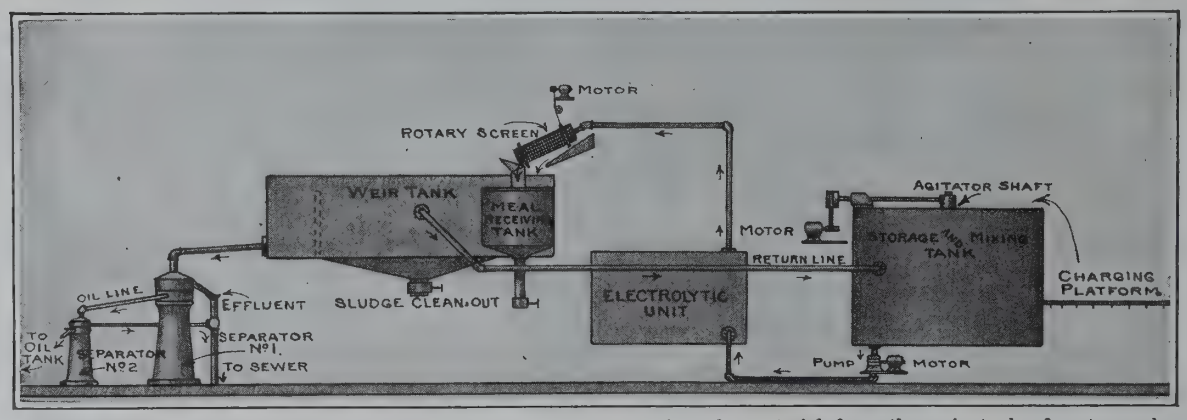
Our illustration shows the end of a suction tube at work in the hold of a steamer loaded with copra. The suction tube sucks the copra and deposits it in freight cars standing on tracks some distance away. This system has just been installed at the Parr terminals in Oakland, Cal., and is reported to be operating successfully with a very appreciable saving in both time and labor.

# Extracting Oil by Electrolytic Action

## A Recently Developed Process Which Bids Fair To Be of Economic Moment

By Robert G. Skerrett

ONCE again we have an example of laboratory research put to commercial service, and science shows us how we can greatly reduce our present wasteful practices and amplify to a notable extent the measure of marketable output obtainable from a given quantity of raw materials. This step forward is the direct result of a discovery made by George D. Rogers, a young chemist, graduated from the Massachusetts Institute of Technology. His professional work brought him in touch with the fish-oil industry, and it was not long before it dawned upon him that the prevailing methods had decided shortcomings.




Separator No. 1 is really a skimming apparatus which does not quite free the material from the weir tank of water and a percentage of the suspended solid matter. Separator No. 2, however, serves the purpose of a clarifier and discharges only clear oil. Should the material in the receiving section of the weir tank give evidences of incompletely treated matter, the charge can be returned to the mixing tank for a second run through the electrolytic unit. Ordinarily the breaking down in the unit would be sufficiently effected in one passage

**Operative cycle of the electrolytic process for the extraction of oils**

Mr. Rogers set himself the task of finding means by which more oil could be extracted from the primary stock; and he seems to have succeeded far beyond his expectations by evolving a process capable of much wider adaptation than at first imagined. The work-sized demonstrating plant now in operation at Gloucester, Massachusetts, is proving extremely efficient, and today is handling a variety of fatty or oleaginous substances in a fashion that reveals the usefulness of electricity in a new field. It is competing with the try-pot, the water bath, and the steam-jacketed kettle, and the results are somewhat revolutionary and of much economic significance.

We learn from the latest figures supplied by the U. S. Bureau of Fisheries that our annual yield of "aquatic oils" of all kinds has averaged for a number of years about 5,400,000 gallons. The importance of these oils has increased by reason of their widening applications, especially since methods of preparation have been developed, such as sulfonation, oxidizing, heat treatment, and hydrogenation, which have made them fit or better suited to employment. We can probably best illustrate what this latest process promises if we explain the usual procedures in the extraction of oil from cod livers, for instance.

It is officially said that "sun-tried" oil represents anywhere from 20 to 40 per cent of the total quantity of oil produced. It is superior to that rendered by cooking. It is obtained by putrefaction of the livers and, as may be imagined, the natural process takes a somewhat protracted period. Very little of this cod-liver oil is used for medicinal purposes. The quicker procedure consists in cooking the livers, and in this two general methods are followed: First, by a water bath, a wood or coal fire supplying the needful heat, and, second, by steam, in either case, the rendering takes from 2 to 3½ hours; and the temperature at no time should exceed 200 degrees Fahrenheit. It seems that it is absolutely necessary to abridge as far as possible the time the livers are subjected to heat in order to secure a really choice grade of oil.

According to the U. S. Bureau of Fisheries: "For the production of the clearest and lightest medicinal oil, the livers should not be exposed to a greater heat than 160 degrees Fahrenheit, and that only for about 45 minutes. This, however, is not feasible because the quantity of oil produced in that case would be too small to make the business profitable. The time must, therefore, be extended as far as practicable without detracting too much from the quality." So much for the state of the art. Now let us see what the laboratory work of Mr. Rogers and the mechanical equipment designed by Robert P. Bennett represent in the way of an advance.

From the time the raw cod livers are placed in the mixing tank and the oil issues from the final separator the procedure does not take at the outside more than three minutes! The actual release of the oil from the fat cells is accomplished in an electrolytic unit, and from that point on the process is devoted to the separation of the oil from the water, sludge, solid matter, etc. The extraction of the oil amounts to almost 100 per cent of the oil content in the raw livers; and the passage through the electrolytic unit takes less than a minute.

*ELECTROLYSIS bids fair to affect profoundly that diversified industry which is now engaged in the extraction of oils, oleo, and tallow from fatty sources. These products play a prime part in our daily life in numerous directions. As foods, as medicaments, as the foundation of soaps, as dressings or fillings for leather, as lubricants, as ingredients in paints, and so on, we use each twelvemonth many millions of dollars' worth of these commodities, and the demand is steadily growing. And that is why we have asked Mr. Skerrett to tell us about a new and remarkable process for the extraction of oil by electrolytic action.*—THE EDITOR.

The electrolytic unit of the apparatus consists broadly of a rectangular box of steel containing a number of straight sections of 2-inch pipe joined to one another by rubber hose. Each of these pipes, known as "coils," carries a concentric rod of carbon one inch in diameter, reaching from end to end of the metal tubes. This leaves an annular channel half an inch wide around the carbon rods, and through this the macerated liver and salt water are driven by a gear pump. The mixture goes successively through all of the "coils" before issuing from the electrolytic unit. The purpose of the hose connections is to insulate from one another the various pipes or cells.

Each carbon rod is insulated from the enveloping metal tube, and the electrical connections for each pipe and each rod are independent, the carbon rods forming negative electrodes and the pipes positive electrodes. When current is flowing, the circuit is completed through the material carried by the electrolyte. The electrolytic action thus induced effects the extraction of the oil, by causing the fat cells to discharge their contents. The explanation of the phenomenon is that the passage of current between the electrodes destroys the balance between the electrolyte and the matter held by it in suspension, and in consequence an osmotic force is set up which brings about the bursting or breaking down of the protein envelope of the fat cells. There is thus recovered about 99.75 per cent of the oil present in the livers.

To appreciate the significance of the electrolytic method, it is said that the "sun-tried" livers yield only from 15 to 35 per cent of their oil content, and fully two-thirds of this is made up of the poorer oils. Where the cod-liver oil is extracted for medicinal purposes by steam-jacketed kettles or the water bath, it takes quite three gallons of livers to produce a single gallon of oil, and even so all of the oil is not fit for medication. By the Rogers-Bennett process, the oil recovered at any time is of a uniform standard—the grade varying only with the age of the livers. Age in this case means the time elapsing between the catching of the fish and the delivery of the livers for rendering. In common practice, the livers must be taken in hand within twenty-four hours after the fish have come from the water. On the other hand, a fine grade of oil, meeting in every way the requirements of the United States Pharmacopœia, has been produced by the Rogers-Bennett system from cod livers six days old, and excellent oils have also been obtained from livers four to six weeks old.

The only heat used in the cycle of the Rogers-Bennett process is employed to stimulate the easy flow of the macerated material through the electrolytic cells. To this end, exhaust steam fills the space around the "coils," and the maximum temperature is about 155 degrees Fahrenheit.

The discharge from the electrolytic unit has the character of an emulsion, and is carried to a rotary screen which diverts most of the solid material into a receiving tank while the oil and finer solid matter enter a weir tank where the sludge settles and the oil and water go on to the sepa-

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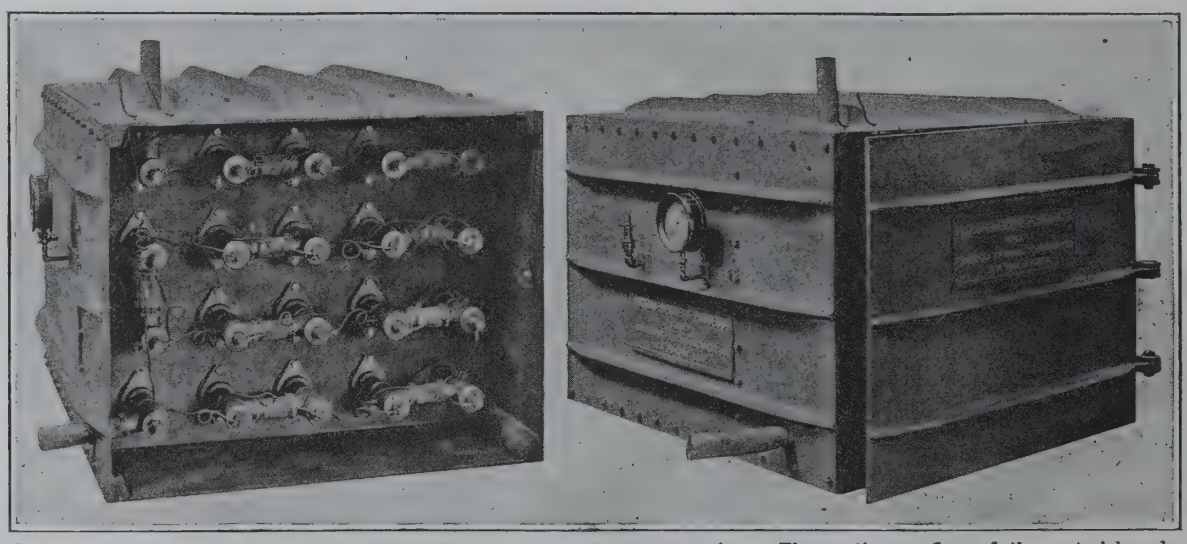

*Left:* An interior frontal view of the electrolytic unit with the door swung clear. The continuous flow of the material under treatment, from coil to coil, is made possible by rubber couplings. The rubber hose is used for the purpose of thus electrically isolating contiguous coils from one another. The apparatus can be taken apart whenever necessary to facilitate cleaning and replacements. *Right:* A 20-coil electrolytic oil-extraction unit showing intake pipe at top of case and discharge conduit at the lower left side. The front is hinged to permit ready access to the electrical connections of the various coils.

**Electrolytic oil-extraction unit used in the successful tests of the new process**

## Melting Gold Coin at New York Assay Office

AS we pass down Pine Street and see the low classical building which houses the Sub-Treasury, we see an inclined wooden path leading to a forbidding looking building whose iron bars suggest a modern jail, but once inside this building we are in Aladdin's cave and hundreds upon hundreds of billions of dollars are in evidence. This unpretentious entrance would in the normal course of events have been closed and sealed up and the new and beautiful façade and entrance on Wall Street would have been open if it had not been for the bomb outrage which is still so recent in the minds of all. The explosion took place directly in front of the Wall Street entrance of the Assay Office and there is little question that as an objective the Assay Office had equal honors with the Morgan bank across the street. The destructive bomb or series of bombs tore pieces out of the stone, destroyed all the windows and warped and deformed the iron grills and other ornamental work in the beautiful office which was to have been devoted to the use of the public. Fortunately, owing to delays of various kinds, there were practically no employes in the new section of the Assay Office, or the death toll, already large, would have been increased by fifty or sixty. It will take many months and a considerable sum of money, which, unfortunately, Congress must appropriate, before the signs of havoc can be eradicated. The old building is not an old building at all; in fact, it is only about ten years old, but is called the old building in contradistinction to the new building which, it is hoped, will be opened by July if Congress appropriates the necessary funds to repair the damage. The older building will be used exclusively for melting and refining, while the new building will be devoted to the assay laboratories, the public reception rooms for those who bring their gold to be assayed, executive offices and several floors of vaults which are so urgently needed. Our cover presents a most interesting phase of the work of the Assay Office—the melting of coins into gold bars.

During the war period hundreds of millions of dollars of foreign gold coin, principally British sovereigns, Japanese yen and French francs found their way to the melting pots of the United States Assay Office at New York. A difficult problem presented itself in the prompt melting and storing of this vast treasure.

Regulations governing the handling of these deposits were so modified as to work no injustice to the depositor. Payment of 99 per cent of the value of the deposit was made, ascertained by their being weighed immediately after receipt when presented in sums of $1,000,000 or over. Of course such deposits come only from banking houses of recognized standing and when advantage is taken of this regulation the depositor is required to give guaranty in writing of the integrity of the coin. With the old regulation of a 90 per cent advance after weighing, the interest loss to the depositor would be considerable in a transaction involving several millions of dollars. Another important change authorized, was the reporting by the assayer on deposits of not less than $5,000 to one-tenth of one-thousandth instead of one-quarter of one-thousandth.

The physical operations involved in the handling of these deposits are as follows: The coin, after removal from the sealed boxes in which it is shipped, is weighed to .01 ounce in drafts of approximately 2,300 troy ounces. The advance payment is made to the depositor after this weighing and is based on the fineness of the coin deposited.

Drafts are delivered to the melting room and are shoveled into graphite crucibles with long-handled scoops. Three drafts or approximately 7,000 troy ounces (480 pounds avoirdupois) constitutes a melt.

Melting is done under cover of charcoal (powdered) to prevent oxidation and the molten charge is dipped from the crucible and cast into bars weighing approximately 340 ounces each. Each bar is given the melt number and returned to the receiving room and weighed to determine the after-melting weight, upon which the final payment to the depositor is based. On new coin the average melting loss is .25 ounce per 1,000 pounds melted. After each third of the melt is poured a dip sample is taken for assay and this is checked by a chip taken from the first and last bar of the cast. The pictures on this page, as well as our cover drawing, represent stages in the assaying process.

The bars, known as certificate bars, are properly marked with weight, fineness and value and stored away in the vaults and gold certificates issued against them. We are indebted to the Hon. Verne M. Borie, Superintendent of the Assay Office, and Mr. E. J. Wager, the melter and refiner, for courtesies in connection with the present article.

## Can Snakes be Charmed with Music?

THERE is no foundation in fact for the common belief that a snake can be "charmed" with music, according to Allen S. Williams, director of the Reptile Study Society of America. Mr. Williams bases his opinion on a series of experiments extending over a period of nearly twenty-five years.

"I have tried every sort of music," says Mr. Williams, "from a tin whistle with note holes in it to a symphony orchestra, and have used as subjects nearly every variety of snake, but have yet to note any response on the part of the reptile.

"Once with a very beautiful panther snake, which because of his red robe we called Richelieu, I thought I saw signs of response, so I laid him on top of the piano while I played. He looked at me steadily for a moment and then slipped off the piano and started for a mouse hole which had once yielded him prey."

In another experiment, Mr. Williams surrounded a violinist with more than 200 snakes. He noted no response to the music from any of them. The belief that snakes are responsive to music probably originated, Mr. Williams believes, from the East Indian fakirs.

These men play on a peculiar reed whistle, swaying their bodies as they play. A snake, usually a hooded cobra, erects its head from a basket before the player and sways with the rhythm of the music. The explanation, Mr. Williams says, is not in the music but in the swaying of the musician's body.

"The vision of all snakes," he says, "is very defective. It has been said that the boa constrictor cannot see as far as his own length. I believe that is an exaggeration, but my own experiments have shown me that the snake sees very little of form or color. The thing which most attracts him is motion. I have seen snakes violently startled by the flapping of a window curtain.

"In the case of the Hindu fakir, the snake follows the motion of the man's body trying to see what is before it, either because it fears the thing might harm it or may prove to be something good to eat.

"I have obtained about the same result with other snakes, with and without music, but the hooded cobra makes an especially good subject for this trick because it has the habit of "sitting up" about one-third of its length.

"In fact the snake, if it had any emotions, would find them hard to express. A dog can wag his tail and actually laugh when he feels like it, but a snake cannot wink an eye for it has no eyelids. More intelligence is usually attributed to a snake, too, than it actually possesses. I believe it to have the least intelligence of the reptiles, both lizards and turtles being above it."

Another fallacy which Mr. Williams believes he has exploded is the belief even among some scientific men that human beings have a hereditary fear of snakes.

"I have never found a little child which was afraid of snakes," he says. "On the other hand children seem to like them. I have found, too, that women are less afraid of snakes than men."

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Pouring molten gold into iron molds

Weighing 2400 ounces of gold

## A Non-Inflammable Timber

A PROCESS has been made public in England by which timber is made fire-proof. It consists in submitting the wood in a closed cylinder to a steaming and vacuum treatment, which removes the air and moisture in the pores of the wood and vaporizes the sap water. The wood is then impregnated under hydraulic pressure with a solution of fire-resisting chemicals, which replace the elements driven out by the preliminary treatment. Finally the water of the solution is dried off, and the chemicals in minute crystal form remain embedded in the fibers. The effect of this treatment is explained as being that on the application of heat the crystals expand and form a glossy coating, which excludes the oxygen of the air and prevents its combination with the wood, thus rendering flame an impossibility. The higher the temperature, the more the crystals expand, and though in time the chemical action of each crystal becomes exhausted and the wood becomes charred fresh crystals come into play, and though the wood may eventually be charred completely through, no flame will be generated. Wood treated in this way does not differ in appearance from wood that has not been treated, and it is claimed that it does not corrode nails or screws.

# The Service of the Chemist

*A Department Devoted to Progress in the Field of Applied Chemistry*

Conducted by H. E. HOWE, Chemical Engineer

## The Electric Furnace in Metallurgy

ATTENTION is called to a reading list comprising some 87 pages of references on the Electric Furnace as Applied to Metallurgy. This is a contribution by C. J. West and has been reprinted from the transactions of the American Electro-Chemical Society, the paper having been presented before the April meeting of that society. The author has attempted to include all the important references since 1900, the date at which electric furnaces were becoming established in the wire and steel industry, and, beginning with 1907, references to Chemical Abstracts are given in addition to enable the reader to eliminate many of the references which might not fit his particular needs. Compilations of this character, involving as they do patient search and tedious examinations, are always valuable contributions and the information that such a list is available will be welcome.

## Synthetic Ammonia

WHILE an attempt is being made to have legislation enacted to help establish a fixed nitrogen industry in America, primarily through the operation of Government plants, remarkable progress is being made abroad. According to the report of the American Chamber of Commerce in Berlin it appears that synthetic nitrates have been developed to the point where Germany is now entirely independent of Chile. By the Haber and cyanamide processes she will not only be able to supply her own requirements but expects to export fixed nitrogen in the near future.

In France the recent researches of Claude have caused quite a commotion, he having succeeded in producing pressures of more than 1,000 atmospheres by methods applicable to industrial uses. He has shown that it is not only possible but indeed easy to attain such pressures and has now applied them to the production of synthetic ammonia. Under the conditions which he obtains, hydrogen and nitrogen combine with such facility that a large output is possible with a comparatively small installation. In the Haber process approximately one-third of a gram of ammonia is produced per gram of catalyst, whereas Claude obtains a yield of ten grams.

## De-tanning Chrome Leather

A BRITISH patent has recently been issued covering a process whereby scrap leather may be de-tanned and the resulting material used for the manufacture of glue and gelatine. The chrome leather is first immersed in a solution of an organic acid, such as phthallic, lactic, tartaric, oxalic, or other organic acids containing two or more hydroxyl groups. The chromium may be recovered from the resulting solution and the de-tanned material treated in the usual manner for making glue or other similar products.

## The Fruit Fly

IN a recent number of the *Chemical Bulletin* David Klein comments upon a popular article in the *Scientific Monthly* for December, 1919, in which Dr. Loeb discusses the results of his experiments with the fruit fly, hatched and bred aseptically. One interesting finding is the duration of life appears to be a function of the temperature to which the fly is subjected. Thus at 30°C. its average life is 21.15 days; at 20°C., 54.3 days; while at 10°C. it is more than 177.5 days. As Dr. Klein observes, if temperature were a factor of equal importance in human life, one would be able to live a prolonged existence at the North Pole and but a brief period at the equator, thus giving him the choice between a long, monotonous existence and a short, merry one. We may find some time that life may be written as a chemical equation and that the sum total of the chemical energy of a life-time is a constant and the length of life dependent upon the rate of its utilization.

## Industrial Alcohol

ATTENTION is called to an article in the March 17th issue of *Chemical and Metallurgical Engineering* on this subject by Burnell R. Tunison. This article treats of industrial alcohol under the new law and regulations, and in addition to defining the various types of alcohol, includes an interesting table of authorized formulas for specially denatured alcohol, and another table giving the products and industries authorized to use specially denatured alcohol. The extent to which industries now depend upon alcohol is indicated by the list of more than a hundred products of very diverse character. The alcohol situation is complicated by scarcity of raw materials, unusual demands and difficulties of transportation and marketing brought about by the difficulties attending the enforcement of prohibition legislation.

## Paper Fibers

TWO promising new fibers for strong paper are reported—one consists of the macerated bark of the cuazuma tree, which occurs in Mexico, and the second the leaves of the doum tree, which grows along the coast of Morocco. The bark in question is sometime 20 to 30 centimeters in thickness and the fiber from it can be produced at a low cost. The doum is a dwarf palm that matures rapidly and the estimate is that 100,000 tons may be available annually. The pulp produces 75 per cent of fiber, which has a satisfactory felting power, great tenacity and suppleness.

## Glue and Gelatine

AN Australian patent has recently been granted on a process to produce glue and gelatine from horns and bones, which are subjected to a solution of hydrochloric acid for a period of five days, the step being repeated until the material has been treated five times. After a thorough washing in cold water, the material undergoes two twenty-four-hour applications of a lime solution, after which it is washed again, dried, and boiled from twelve to eighteen hours. The thin liquid may then be skimmed off and dried and comprises pure gelatine, while the thick liquid contains the glue.

## Pyroxylin

AN American patent has been granted on a process devised to decrease the inflammability of pyroxylin. Commercial pyroxylin is dissolved in methyl alcohol containing five per cent of acetol. The solution is then diluted with carbon tetrachloride and chlorinated in the presence of a carrier such as zinc or tin chloride, until five to eight per cent by weight of chlorine has been absorbed by the pyroxylin. The solvents may then be evaporated off and the chlorinated pyroxylin washed, neutralized and dried in the usual manner.

## Aluminum from Labradorite

A PROCESS has recently been developed in Norway for the extraction of alumina from labradorite. The mineral is dissolved in dilute nitric acid made locally by the fixation of atmospheric nitrogen, and the impurities remain in the residue. Evaporation and heating to a point at which the aluminum nitrate left is decomposed, is carried on and the calcium and sodium nitrates are dissolved in water, leaving a pure aluminum oxide. Pure labradorite contains about 30 per cent alumina, which is equivalent to 16 per cent aluminum. It must be that this mineral as found in Norway differs from that occurring in America, as the labradorite usually found here is not sufficiently soluble in nitric acid to give promise of working the process on a commercial basis.

## A New Abrasive

THERE has been need for some time for an abrasive having extreme sharpness, long life, uniformity and fast, cool-cutting ability. In addition it should be possible to form a wheel from this material that would be what is known as "open" and brittle in its structure. Research has at last provided such an abrasive, composed of large alumina crystals and the impurities present probably do not exceed 1.5 per cent, which is very much less than in the case of the ordinary type of aluminous abrasive. When a rupture occurs in such a large abrasive grain it means that a crystal of alumina has been actually fractured, the principal result being the provision of new sharp-cutting points and edges.

## Cottonizing Vegetable Fibers

A PROCESS for cottonizing such fibers as jute, hemp, flax, and any vegetable fiber which has a woolly or hair-like feel, has been reported. The waste fibers are passed through a device which tears them apart; they are then crimped, but the process does not reduce the larger fibers to the point where other than coarse yarns can be spun. These fibers thus treated by a mechanical process are not so smooth as those produced by chemical treatment, but they produce greater strength largely on this account. The chemical process employs both sodium hydroxide and chlorine, as well as oil soaps and peroxides, which develop nascent oxygen. The dry fiber is washed in a way to force the fluid through the material and in order to make this treated fiber more suitable for spinning a strong, cold caustic soda solution is recommended, after which it is washed in hot water.

## Chlorine and Influenza

DR. CHARLES BASKERVILLE, in speaking on this subject, points out that while the data thus far obtained do not warrant drawing conclusions, such facts as have been established would indicate to the medical man the advisability of trying experimentally dilute chlorinated air as a prophylactic in such epidemics as so-called influenza. Dr. Baskerville determined to what extent workers in plants where small amounts of chlorine were to be found in the atmosphere were affected seriously by influenza and many of those from whom information was requested expressed the opinion that chlorine workers are noticeably free from colds and other pneumatic diseases. One plant in which fifteen per cent of the employes were infected reported no cases in the chemical building, where chlorine was produced, nor did any occur among the employes in its bleaching room.

## Light Alloys

IT is interesting to note that the majority of the light alloys in the United States are aluminum-copper, whereas abroad aluminum-zinc is more often found. This is said to be due to our lack of information regarding the aluminum-zinc series, and to supply the missing information, extensive research work has been undertaken on this class of materials by one of the large zinc-producing companies. The production of aluminum is rapidly increasing in the United States, and it is predicted that by 1930 the total production will equal, if indeed it does not exceed, that of copper. Aluminum as an element in die-casting has caused a number of difficulties, which are, however, being gradually overcome, and at present 150,000 castings can be made from a single die. There is no question but that aluminum has come to stay as an engineering material, the possibilities of which have by no means been exhausted.

## Heating Wood Before Gluing

IN its Technical Notes the Forest Products Laboratory points out that in joints of small area, where the gluing is done in warm rooms in the absence of a draft and the wood itself is at room temperature, little is to be gained by pre-heating the wood. In fact, under such conditions, heating may be detrimental, since the glue will be kept thin and squeezes out when pressure is applied. However, when joints several inches each way are glued, pre-heating has a distinct advantage and unless heated, the joints develop their full strength only in spots. It has been found that joints of large size can be produced of uniform high strength if the wood is heated for from ten to fifteen minutes at from 120° to 130°F. just before gluing. The heat prevents the glue from chilling and keeps it liquid until pressure is applied. The rate of set is retarded, full joint strength being developed in ten hours in mahogany and more than twelve hours in red oak and maple, whereas cold-glued joints reach their full strength in less than eight hours.

## Chemistry and Brazilian Imports

A LAW has been passed in Brazil providing for the establishment at once of laboratories at ten of the ports where all kinds of fabrics, chemical products, drugs, pharmaceutical preparations, canned meats, and fish and all products used as foods or in the preparation of foods and drink are to be tested. Later other laboratories are to be established in custom houses at other ports, and a fee of 2 per cent of the total import duties will be levied to cover the costs of making the analyses. The object is to prevent the introduction into Brazil of articles injurious to the public realth.

## San Francisco's Traffic Convention and Street Safety Show

By C. W. Geiger

FOR the first time in the history of the United States a foreign government has "sat in" for the purpose of creating a common police law, for the United States and Canada. Both nations will be allied in framing this great and beneficial law that will enable the motorist to travel from the Atlantic to the Pacific Coast, either through the United States or through Canada, and meet with only one general condition everywhere, thereby relieving the motorist from the embarrassment and annoyances that he must now endure in extensive travel.

The primary purpose of the Third Annual Convention and Safety-First Exposition of the International Traffic Officers' Association at San Francisco is to obtain an international viewpoint on traffic conditions and crystallize this viewpoint into a uniform Motor Vehicle Act to be presented to the various legislatures at their next sessions. The need for uniform traffic regulation is great, and universally known, so it is hoped that out of this conference and meeting of those who are thoroughly conversant with all traffic conditions, such uniform legislation will come. It must be so broad in scope that it will take care of the pedestrian as well as the motorist, and in such shape that it can and will be enforced to the benefit of the people, making our streets and highways safe for all users.

**A test of braking power, in which the car going 20 miles per hour was brought to a standstill in six feet**

The street in front of the Exposition Auditorium was turned into an outdoor laboratory for every sort of traffic test. The pavement was even hosed down by the fire department for the proper slipperiness for a skidding demonstration. One test arranged was to show the proper distance in which a car should stop in an emergency, the demonstrating cars turning a corner and pulling up short at various speeds. At a speed of 15 to 20 miles an hour a car was brought to a dead stop in six feet. For these tests the street was marked off with white paint, indicating to the driver where to start his stop.

A hundred or more automobile offenders got a novel warning when the traffic policemen in the down-town region of the city gave them formal printed admonitions to go take a look at the safety-first stunts, where there was displayed what is probably the largest and most complete exhibit of safety-first devices for automobile traffic ever shown in this country. Arm wig-wagging, judging from the exhibits, is already a thing of the past, superseded by the little arrow signals which are attached to the windshield, or by rear colored lights, or by work signals flashed to the accomplishment of a bell. The blinding glare of approaching headlights is dimmed by an adjustable violet glare-shield attached to the steering wheel; by violet-ray lenses; or by lenses supplied with a fin or shelf or specially treated glass which acts as a shield between the light and the eye of the approaching motorists. Prominent among the safety devices is a safety bumper which automatically stops the car and sounds a horn when it strikes another auto. This bumper promises to make safe the lives of little children caught unawares as it stops within a few feet when going at twenty miles an hour, and is too low to the ground to admit of anyone being dragged beneath it. Everything is done mechanically so as to leave the driver as free as possible to guide his car, and yet make it simple to meet the requirements of the motorists laws.

Other notable features of the exhibit are the safety devices to guard the car against theft. These include locks for the steering wheel, which defy picking, and chain tire-locks.

In keeping with the traffic convention a splendid traffic regulator, on the order of the railway signal systems, was exhibited for use on city streets. It consists of a semaphore placed on posts at the intersection of streets, and provided with lights, bells and

(*Continued on page 440*)

**The auditorium in which the safety-first exhibition was held, showing a group of the exhibits**

## Something New in Gasoline-Driven Plowing Machines

By James H. Rodgers

WE are told that there is nothing new under the sun. In a broad sense this is probably true, but variation in the application of certain well recognized principles frequently creates machines that may, without exaggeration, be properly classed as extremely original. Such is undoubtedly true of the plowing machine herewith described and illustrated. What, at a distance, appears to be some queer development of a flying machine, with its wings outstretched, resolves itself, at closer range, into an interesting but distinctive type of plowing machine.

To the person unfamiliar with mechanics, the initial sight of such a machine is somewhat astounding, but keener observation, particularly when the plow is in motion, impresses one with the vast possibilities of such a unique machine.

During the war, and since, the factor of man-power for agricultural purposes has been rather a serious problem. As a partial solution to this question the adoption of machinery capable of performing more work with less labor appeared to be the best means to the end sought.

The illustrations show several views of this new plowing machine, the design of which is out of the ordinary, and demonstrates a radical departure from the usual present day practice of tilling the soil. The designer of this machine, Mr. L. A. Desy, civil and mechanical engineer of Montreal, Quebec, has made several successful preliminary trials on a farm close to Montreal, and the initial performance has more than met the fullest expectations of the builder.

**Two views of the machine that puts plowing on a quantity basis by means of an endless belt of plowshares**

Unlike the ordinary plow, where the furrows are made parallel to the travel of the machine, the method of operation in this plow causes the plow shares to move at right angles to the forward movement of the tractor, resulting in a furrow that converges toward the center at an angle of about 20 degrees, leaving the plowed land with a herringbone appearance.

In operation, the plows travel toward the center of the machine, seven of the plows on each side being in the ground at one time. The width of the land covered at one passage of the machine is approximately 40 feet.

When turning at the end of a field the two plow arms can be raised so that the plow shears and the disks are clear of the ground, and the machine can be turned in its own length by means of the steering wheel and the caterpillar tractors. When desired, a start can be made from the very end of a field, as the tractor can be backed right up to a fence, if necessary. The machine, however, is intended for Western plowing, where large tracts of land are under cultivation.

The machine shown has an approximate weight of eight tons, and under tests on land that had not been plowed in several years, it covered about 30 acres in a day of ten hours.

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

**This simple tool twists a wire about a bag to tie it**

## Making a Twist of the Wrist Tie a Bag

WIRE for tying bags is being used to a large extent. So interest attaches to a special wire-tying tool that has lately been devised and that makes possible the tying of large numbers of bags during a working day. Wires are cut of sufficient length for a perfect tie and no material is wasted. A workman once taught the trick of the twist necessary to bend the wire, can fasten securely many more bags than when using twine.

## Briquets from Coal

PUBLISHED reports say that the Lignite Utilization Board, which has been for months experimenting with the problem of cheaper fuel for domestic use from the low-grade coal found in southeastern Manitoba and Saskatchewan, has arrived at a satisfactory manufacture of briquets.

The chairman of the board has expressed the opinion that the engineers have succeeded in finding a system for the manufacture of briquets that will probably produce fuel equal to the best grade of the United States anthracite coal, and which will be even more satisfactory for domestic use.

The board has decided to erect an experimental plant with a capacity of 30,000 tons a year. The plant will doubtless be located near the mines operating in Saskatchewan, close to the Manitoba boundary.

The chairman of the board further says that a careful analysis of the costs leads to the belief that briquets can be manufactured and loaded on cars at the plant at about $7.50 a ton.

It appears that the Canadian Utilization Board entered upon its work over a year ago and was organized as a result of an agreement between the Dominion Government and provincial governments of Saskatchewan and Manitoba. The Dominion Government appropriated $200,000 and the provincial governments each $100,000 to meet the expenses of carrying on this work.

**A transformer in the base of this night lamp reduces 110 volts to 6 volts**

## Use of Potato Flour in the Netherlands

AS a result of the continued high price of wheat flour it is announced that the Government of the Netherlands is arranging for the mixture of potato flour, manufactured in the Netherlands, with wheat flour from the United States to augment and cheapen the supply of breadstuffs in the country. It is announced that the Government has recently purchased from local manufacturers a stock of 20,000 metric tons of the potato product which it proposes to mix with the imported product. The potato flour bought by the Government costs 6.4 cents per pound as compared with practically the same price for wheat flour at the present time, but a somewhat higher price on an average for some time past. It is expected that by mixing the potato product with that of wheat any further rise in the cost of bread can be prevented, though it is understood that the fixing of a maximum price for bread will again be undertaken if that becomes necessary to prevent any serious rise in the cost of this staple food to the Netherlands people.

Both potato flour and potato starch have been used as constituents for bread during the war. There is considerable indisposition on the part of the Netherlands public to use flour containing the potato starch which, particularly during the war, was usually not of good quality, but it is anticipated that there will be no complaint as to the use of the potato flour which, when properly mixed with the wheat product, is said to make very good bread not much different from that in ordinary use in the land of dikes and canals.

## A New Light That Costs Next to Nothing

BY the ingenious combination of a small step-down transformer and an automobile incandescent bulb, an inventor has recently introduced a night light which costs practically nothing to operate. Indeed, this light, operating on the standard alternating current supply lines, hardly affects the usual meter, hence the cost is negligible.

The principle of this new light, which is shown in the accompanying illustration, is merely the stepping down of the 110-volt alternating current to 6 volts in order to supply the necessary current to a 6-volt 2-candle-power bulb. The transformer is placed in the base of the porcelain body of the lamp. A bayonet type socket holds the lamp, which can be flashed on or off by the switch shown in our illustration. The hood of this attractive little lamp is so designed as to direct the light rays where they will not trouble the person making use of the lamp.

## A New Use for Rubber Tubing

OF the many methods employed to keep the milk bottle clean and sanitary, the milk bottle top with rubber tubing run around the inside is one that should appeal to those of us who prefer their milk sanitary. It makes the bottle absolutely tight, and avoids the accumulation of dirt in inaccessible corners, since it can be removed for perfect sterilization.

**No longer is the scrubber obliged to get down on the knees or wring the mop with the bare hands when using this improved mop**

## Taking the Scrubber Off Her Knees

EVIDENTLY the inventor of the new mop depicted in the accompanying illustration became tired of having scrubbing done on the knees, and wringing the mop out by hand wringing. For with this mop the worker, through the use of an arrangement of gears and suitable handle, can wring the mop by turning a crank handle and scrub and dry the floor while standing in an upright position. The knitted mop head used is all in one piece and is easily removable when a new drying medium is needed. Once the mopping surface is placed against the floor, it lies perfectly flat and does not require a stooping position of the worker in order to secure this result.

## New Cleaning Tool for Housekeepers

BEFORE this recently-patented cleaning device for brushes was available, either the hand was used to remove lint and hair from the revolving brushes in carpet sweepers and vacuum cleaners, or a metal comb. The work was highly disagreeable, to say the least. The present cleaner is like a cat's claw. It is strongly made and will remove the strongest accumulation of strings, hairs, etc. It is said to do its work without pulling out the bristles in the brushes.

**The rubber tubing in this cap renders it sanitary**

## Recent Patent Decisions

**Defense on Intimidation.**—This is an action for damages to plaintiff in his business of selling a varnish by reason of defendant's unfair competition. The plaintiff had manufactured and sold a varnish called "Varnish No. 25." It was manufactured by a secret process, was a varnish in its nature, composed of ingredients in such a way that it was free-flowing and reasonably quick-drying. It was commonly used to inject into tires of a bicycle to fill pores or small punctures in the rubber bicycle tires, and was manufactured by the plaintiff for that purpose.

The defendant by assignment became the owner of a combination patent issued to Chas. E. Duryea. This patent covered the use of a free-flowing gummy fluid within a pneumatic tire for sealing punctures. At the time of the purchase of the patent by the defendant, there were several compounds similar to that of the plaintiff being manufactured and sold in different parts of the country, and the defendant immediately began an active campaign to force the discontinuance of the manufacture and sale of them, claiming that its patent granted to it the exclusive right to use any liquid or powder inside a hollow pneumatic tire for the purpose of sealing punctures.

The failure of defendant, manufacturer of a fluid to seal punctures in pneumatic tires, to sue plaintiff, manufacturer of a like fluid, for infringement of patent, and defendant's publication of letters, circulars, and envelopes, which he used to threaten plaintiff's customers with suit if they continued to use plaintiff's fluid or varnish, held to be consistent with the good faith of defendant in the exercise of an intent to protect its business, thereby not warranting a jury in finding any malevolent motive to harm plaintiff in the destruction of his business rather than in legitimate endeavor to protect patent.—*Edwards v. Buff. Spec. Co. Supreme Judicial Court of Mass.*

**This claw-like device enables one to clean the vacuum cleaner brush with ease**

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

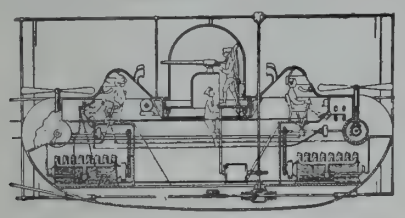
## Pertaining to Apparel

NECKTIE.—A. M. BAKERMAN, 413 E. 138th St., New York, N. Y. The object of this invention is to provide a self-tied neck tie of the four-in-hand model, manufactured to resemble a tie as usually worn and tied on and around collars. A feature is to provide a tie in which all the parts are so arranged that the tie may be quickly adjusted into place and securely held in service position.

SWEATBAND FOR HATS.—J. C. PETERSON, 34 N. Gifford St., Elgin, Ill. The invention has for its object to provide a sweatband which can be adjusted to fit any ordinary hat, which will allow of circulation of air around the head, and which can be removed and replaced as desired. A feature is to provide a band of conical form conforming with the shape of the head and not with the shape of the hat as is customary.

## Pertaining to Aviation

FLYING CRUISER.—N. G. Cox, Livengood, Territory of Alaska. The invention relates more particularly to such flying machines as are suitable for use at times as vessels capable of floating in water, and adapted for service in warfare. Among the objects is to provide



A VERTICAL SECTION SHOWING THE VARIOUS MECHANISMS

extensible wings so arranged that they may be increased or diminished, or folded, and thus rendered inactive, and to provide afcilities rendering the vessel self-supporting, and to provide propellers so arranged that the axes thereof may be shifted to different angles relative to the hull of the vessel.

## Electrical Devices

INDICATOR.—J. W. CARTER, JR., 5th and Pine Sts., Abilene, Texas. The object of the invention is to provide a device especially adapted for use on storage batteries, to indicate the date of the last watering, and that of the next, both in winter and in summer, and to indicate the date of charging, and whether full or partly charged, and so arranged that it may be locked to prevent accidental displacement or tampering.

ELECTROPLATING APPARATUS. — W. DIETZEL, Merrick, N. Y. The object of the invention is to provide a plating barrel whereby the operation is reduced to a minimum. Another object is to provide a barrel which may be charged from a number of different points without the adjustment of any parts and may be discharged by merely a reverse rotation. A further object is to provide a device so constructed as to hasten the plating operation.

## Of Interest to Farmers

MARKER FOR PLANTERS.—O. H. KOHLHAAS, Calumet, Mich. The invention aims to provide a device particularly adapted to be used in connection with a planter, such as a corn planter, the marker being adapted to be operated substantially simultaneously with the seed dropping mechanism so as to subsequently indicate the location of the various hills. A further object is to provide an extremely simple mechanism which might be applied to any type of planter.

## Of General Interest

FOUNTAIN PEN CLEANER.—C. W. GARVER c/o Western Union Telegraph Co., Ashland, Ohio. The invention has for its object the provision of a simple, inexpensive and efficient device of the character specified, in the form of a tubular casing of suitable material, adapted to receive in one end the pen supporting portion of a fountain pen, and to engage within the other the outlet of a water faucet.

DEVICE FOR TEACHING PENMANSHIP.—J. D. W. WILLIAMS, Tabor, N. C. The purpose of the invention is the provision of a simple and efficient device of the character specified which will exercise and train the muscles of the hand and arm in the formation of ovals. It is well known that the oval constitutes the fundamental figure in penmanship, with the pupil's muscles trained to accurately form such a figure a great stride has been made to writing legibly and rapidly.

LAWN EDGE TRIMMING GAGE.—J. LEES, 1705 W. Broad St., Bethlehem, Pa. The object of the invention is to provide a gage bar of metal construction, which can be pinned along the edge of a walk so that a cutting implement can be used in connection therewith in trimming off the turf in a smooth and even manner. A further object is to provide a gage which is adjustable so that at the edges of various widths can be trimmed and a cutting implement to be used in connection therewith.

WEATHER STRIP.—O. S. BRANHAM, 323 No. Virginia Ave., Roswell, N. M. The invention has for its object to provide a strip of the character specified, mounted to move laterally and longitudinally of a door and controlled by the opening and closing of the door for movement in such lateral and longitudinal directions, to tightly seal the space between the bottom of the door, and the sill when the door is closed.

LAMP BRACKET.—R. F. FERGUSON, 550 Waterloo St., Detroit, Mich. The invention has for its object to provide a simple and inexpensive bracket of the character specified, wherein a maximum of adjustment is permitted. In operation the lamp is arranged on an angle plate, the angle of which may be adjusted to vary the beam of light and after the parts are adjusted they may be securely locked.

FLOWER HOLDER.—MARY G. TILNEY, 935 Government St., Mobile, Ala. The invention provides a trough or water container with a wire mesh cover adapted to be sunk into the ground over a grave. Cut flowers are placed on the grave with their stems projecting through the mesh into the water in the container and are thereby kept from wilting.

CARD APPLIANCE.—H. MAIER, 1148 Hancock St., Brooklyn, N. Y. In order to assist cripples in the playing of card games the inventor has provided a device with which a one-armed man may shuffle and deal cards with the same facility as that of a normal man. The device is of very simple and inexpensive construction.

CLOTHESLINE HOOK.—H. C. LAFFERTY, 9528 116th St., Richmond Hill, N. Y. An object of this invention is to provide a clothesline hook which has a main supporting forked arm adapted to secure a clothesline thereto without the tying of knots. The device is provided with one or more auxiliary hooks to which several runs of clothesline may be attached.

FASTENING DEVICE FOR EAR ORNAMENTS.—H. T. MOLER, 1720 8th Ave. No. Birmingham, Ala. The invention is an improvement in fasteners for ear ornaments, and has for its object to provide a simple and efficient device for securing an ornament firmly in place on the ear in such a manner that it will cause no inconvenience. The device will follow the natural curve of the ear and may be easily detached when desired.

ADVERTISING DEVICE.—L. D. WHEATLEY, 564 E. Oak St., Portland, Ore. The device will simulate perpetual motion. A wheel is mounted between a pair of set screws carried by hollow standards. The point of one of the set screws is revolved by flexible shaft connection with a motor in the base of the mechanism. The other set screw is connected with the motor in such a way that when it is screwed back to remove the wheel the motor is stopped.

LIFTING DEVICE OF GRAPPLE.—M. CLOGSTON, 915 Harrison Ave., Terre Haute, Ind. The present invention provides a grappling means for effectively engaging with boxes, crates, cases and the like, which will be readily releasable when pressure is released so as to avoid the necessity of special tools for knocking the grapple free. The engaging elements may be readily detached for sharpening or substitution.

PROCESS OF PREVENTING THE INNER WALLS OF RUBBER HOSE FROM STICKING DURING MANUFACTURE.—F. C. MORSE, Canton, Ohio. A process is herein provided by which the uncured core or tube after being formed and before being braded may be economically treated so that it may be left for any length of time without any danger of the inner walls of the tube sticking together, should the tube become compressed for any reason.

FEED BOX.—R. R. STICKLER, R.F.D. No. 1, Wausau, Wisc. The invention provides an improved feed box for feeding cattle, which is attached to the stanchion by a system of levers which permit of swinging the feed box out of reach of the cow when not in use and of swinging it into position in front of the cow when the cow is to be fed.

GEOMETRIC FIGURE.—E. T. MILLER, San Antonio, Tex. A new geometric figure is provided for plotting and delineating a pattern for a covering for balls. The coverings are so formed as to require a minumum length of closure, thus lessening the amount of sewing necessary for the complete closure of the covering over the ball.

TOOTHPICK DISPENSING DEVICE.—C. H. BENNETT, 107 Chapel St., Mount Morris, N. Y. An object of the invention is to provide a sanitary device which will prevent the handling of the toothpicks and present one at each operation. A further object is to provide means for operating a cylindrical toothpick receptacle having a gripper thereon which is movable into the receptacle to grip a toothpick and convey the same to a position outside of the receptacle at each operation of the device.

ARTIFICIAL LIMB LOCK.—L. E. HULLINGER, 255 Bergen St., Brooklyn, N. Y. An object of the invention is to provide a lock for an artificial arm, by means of which the lower arm may be locked in any number of positions with respect to the upper arm. The invention aims to provide such a device by means of which the wearer may be capable of performing certain functions in a far more simple manner than has been the practice heretofore.

COAT HANGER.—J. L. WEBER, 407 S. Clinton St., Chicago, Ill. Among the objects of the invention is to provide a coat hanger which can be readily adjusted to be suitable for coats of different sizes, which can be folded to permit of its being carried in a pocket and which is simple and durable in construction, light in weight and can be manufactured cheaply.

FLEXIBLE CONNECTION.—R. STAR, 253 Bergen St., Brooklyn, N. Y. The invention relates to hose pipe connections. Among the principal objects are to avoid breaking extensible members forming flexible connections between relatively rigid devices, to provide a tabular member freely extensible without danger of rupture or damage to the structure, and to simplify and reduce the cost of manufacture of the connection.

CONDIMENT HOLDER.—P. P. DEAGUIAR, 156 Water St., New York, N. Y. The invention relates more particularly to salt shakers, an object being the protection of the salt from moisture so that it will not become lumpy or moist and can be readily shaken from the holder. A further object is to provide a holder which will be entirely sanitary, comparatively cheap to manufacture, and neat and attractive in appearance.

FOLDING CAMP BERTH.—W. F. MOODY, 6 Boston Bldg., Denver, Colo. The object of this inveition is to provide a knock-down structure which can be packed in relatively small space and which can be quickly assembled to form a portable double-deck berth providing four cots or beds in a single unit, and which is capable of assemblage of units in any desired number.

CARRIER FOR EXPLOSIVES.—C. A. COTTLE, 25 Church St., Edwardsville, Pa. The object of the invention is to provide a carrier adapted to receive a number of sticks of explosive. The device comprises a cylindrical casing including a body closed at one end and open at the other, a cover telescopically engaging over the open end, staples carried by the body to receive a strap handle, and a hasp engaging one of the staples to provide for a padlock or fastening at the opening end.

TORPEDO TRAP.—V. H. MASTERS and M. G. SHOOP, 315 N. French Ave., Sioux Falls, So. Dak. The invention has for its object to provide a trap wherein upper and lower sections, the free end of the lower section being buoyed to cause it to rise to the surface when unrestrained and being normally held below the surface by a counterweight, the sections supporting between them a net for engagement by the torpedo, the net being connected to mechanism for releasing the counterweight when the net is struck to cause the trap to lift the propeller of the torpedo out of the water.

AUTOMATICALLY OPERATED SUPPORT.—S. E. SUDBURY, 703 E. 6th St., S., Salt Lake City, Utah. The invention relates more particularly to an automatically operated support for use in connection with furniture and cabinet work. An object is to provide a pivoted support having a slot for the passage of a pin, the pivoted and slotted support including a switch head having an automatically operating switch for controlling the movement of the pin in closing a lid or similar device.

ADVERTISING ATTACHMENT FOR SCALES.—A. N. FUNJ, c/o Auto Advt. Weighing Machine Co., Houston, Texas. The invention has for its object to provide an attachment of the character specified, wherein a series of display members are provided, mounted to be moved into different positions, to bring different matter into display position and controlled to movement by the stepping onto the weighing platform of the person to be weighed.

HAIR FRINGE.—M. MULLER, address Wm. Kaufman, 1482 Broadway, New York, N. Y. The object of this invention is to provide a hair fringe adapted to be worn over the user's hair at the back of the head to provide a bobtail effect without requiring bobbing of the natural hair. Among the objects is to permit of quickly and securely fastening the hair fringe in position on the head or removing it when desired.

ORNAMENTAL ROPE.—C. A. REED, Williamsport, Pa. The invention relates to fringed ropes or strings adapted to be used for ornamental purposes, the object being to provide a rope of this character of simple and efficient construction. The several strips comprising the rope may be of variegated colors so that an ornamental effect is produced.

PENCIL.—W. K. HOLMES, 409 Pearl St., Brooklyn, N. Y. This invention relates to a pencil in which the lead is projected from a barrel by relative rotation of the pencil parts. A feature of the invention is that while the lead is projected by the relative rotation, it is not retracted thereby, but is provided with a yielding holder and upon the withdrawal of the projecting parts the lead must be pushed in against the pressure of the yielding lead holding means.

SILL CONSTRUCTION.—F. N. MARVICK, 608 W. 5th Ave., Pine Bluff, Ark. The invention has for its object to provide a construction of the character specified wherein the heavy wooden sill generally used is replaced by a plurality of pieces of relatively small cross sections, thus permitting heart pieces to be used, and a perfect insulation against dampness provided.

COMBINATION CLOSET SEAT AND BIDET.—DE FOREST L. RATHBONE, Box 1020, Jacksonville, Fla. The object of the invention is to provide a device capable of use in the ordinary manner as a seat and having a bidet or douch fixture in connection therewith, connected with the water supply and normally in inoperative position, and concealed by the seat but capable of being brought into operative position when desired.

SHOE HEEL.—E. S. HELWITZ, 1443 E. 9th St., Brooklyn, N. Y. The object of the invention is to construct an elastic pad for "French" heels in a very durable and economical form, and to make it attachable to the leather heel without the use of screws, tacks or other devices, and so constructed that the pad may be removed or attached readily and will not become a necessarily unseparable part of the shoe.

CHART HOLDER.—C. W. BABCOCK, 221 Harvard St., Brookline, Mass. The invention relates to means for supporting charts and map holders to be used aboard ships. The object is to provide a holder which will be easily adjusted to fit various lengths of charts or maps, and to support and hold them in taut condition, a chart holder frame being provided to expose the charts to view during navigation.

SCREENING OR FILTERING APPARATUS.—H. D. WELLS, 35½ Grant Ave., Glens Falls, N. Y. The object is to provide a screening or filtering apparatus designed for use as a pulp thickener or as a pulp washer or as a water filter. Another object is to

## RECENTLY PATENTED INVENTIONS

provide an apparatus which has a large capacity, requires little or no labor attendants, avoids loss of pulp and reduces cost of wear and labor to a minimum.

COMBINATION HEEL.—F. J. McEwan, 531 N. Lawler Ave., Chicago, Ill. Among the objects of the invention is to provide a combination heel which has greater resiliency and durability than a solid rubber heel, which may be adapted to shoes of various sizes, and which will not slip on a wet surface, or be noiseless in a manner objectionable to many persons.

HYDRAULIC JOINT CARTRIDGE.—E. Rimailho, 98 Rue de la Victoire, Paris, France. The present invention has for its object an arrangement of removable joints, the organization of which is designed in view of insuring the easy replacing of the same whatever may be its apparent complexity. For this purpose all the organs of the removable joint are assembled upon a same mounting which is previously located into a mounting tube in which the joint is definitely adjusted for the use to which it is intended.

ROAD TRAIN.—E. Rimailho, 98 Rue de la Victoire, Paris, France. This invention relates to a road train formed by an automobile set comprising a transporting vehicle, the load transported by which produces the energy necessary for the transporting vehicle The set may be applied to the transport of all burdens, especially of vehicles, and in particular of ammunition and ordnance vehicles in the form of caterpillars.

PRINTING MACHINE HAVING AN OSCILLATING IMPRESSION CYLINDER. — C. Winkler, Berne, Switzerland. The invention relates to a system of tapes for holding the sheets during both the printing operation and the subsequent delivery of the sheets to the leading out device. By this invention the back edge of the sheet during the backward oscillation of the impression cylinder is prevented from leaving the cylinder before the proper time, thus, a good delivery of the sheet is assured.

COLLAPSIBLE BOX.—L. S. Lundy, Niagara Falls, Ontario, Canada. The invention relates to boxes made of cardboard, corrugated paper board, or suitable material. The object is to produce a collapsible box so constructed that it may be opened to remove its contents without destroying its usefulness, as a sealed container, and whereby it may be used a plurality of times, thus effecting a considerable saving.

REFLEX FOCAL PLANE CAMERA.—M. B. Boyce, 2 5th Ave., Haverhill, Mass. This invention relates to cameras of the automatic reflex focal plane type. A specific object is the provision of a camera having a moving picture lens and an adjusted moving picture shutter in combination with means for releasing the shutter, which latter is motor driven by a spring, the tension of which can be adjusted as desired. The camera is designed for moving picture films which will permit of enlargements with highly satisfactory results.

CANNING FOOD PRODUCTS.—J. F. Tronconi, Calle Maipu 671, Buenos Aires, Argentina. The invention relates to the method of canning food products, including meat as a main ingredient. The process consists in providing a can or container with a lining of gut in its interior, in such a way that after introducing the product, the latter will be entirely wrapped in the lining of gut, thereby preventing a direct contact with the can and providing at the same time a means for extracting the contents as an entirely wrapped block.

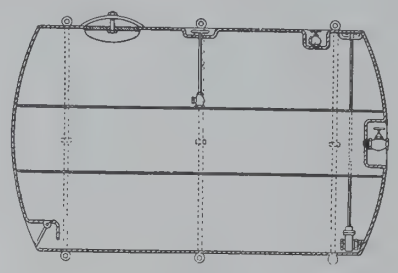
SHOE FASTENER.—P. Ferris, address E. A. Ferris, Westwood, Cal. This invention has for its object to provide a shoe with a series of independently operated fastening devices which can be conveniently attached or replaced when worn or broken and which will permit the shoe to be secured around the ankle and foot to conform to the shape thereof by reason of the fact that the individual fastenings can be adjusted so that they may be of varying lengths at different points on the shoe.

POST AND SIDE BAR OF BEDS, FURNITURE AND THE LIKE.—B. S. Gamble, West Perth, West Australia, Australia. The purpose of the invention is to form a joint or connection between the upright or leg and the side bar of a bedstead or other article of furniture or fitting in connection with like purposes. The invention is in the form of a steel bracket and plates and may be applied to articles of various material although especially applicable to wooden bedsteads and other wooden furniture.

DRIER.—G. L. Spencer, Riverbank Court, Cambridge, Mass. The invention aims to provide a device by which an operator shall be enabled rapidly to determine the amount of moisture in laboratory tests of various substances, particularly raw sugar. A further object is the provision of an oven which will enable the analyst to make rapid control tests in factory work, and in laboratories generally.

CANDY WRAPPER.—W. S. Stoner, 90 West St., New York, N. Y. The object of the invention is to provide a wrapper which will not only act as a protection for the candy but at the same time so construct the same as to offer unusual inducements to the purchaser in that aside from purchasing the candy they are in reality purchasing, a paper doll which may be used as a source of amusement after the candy has been removed the wrapper still retaining its doll characteristics.

SALVAGING APPARATUS.—C. Sanger Bay St. Louis, Miss. The invention relates to the salvaging of sunken vessels and the like. The prime object is to provide a tank capable of being submerged by filling the same with



A LONGITUDINAL SECTIONAL VIEW OF THE TANK

water which is subsequently discharged from the tank to render it buoyant. A further object is to so construct the tank that it contains suitable means for discharging the water and means for controlling the discharge.

THREAD CUTTER.—Helen. S. Carson, Hyde Park Hotel, Chicago, Ill. An object of this invention is to provide a thread cutter attachable to a sewing thimble, which is so small that it will in no way interfere with the functions of the thimble, and still have the cutting edges so effectively arranged that the thread can be readily caught and cut by a stroke to the right or left.

SYRINGE.—O. O. R. Schwidetzky, Hasbrouck Heights, N. J. Among the objects of the invention is to provide a syringe consisting of a glass barrel and a rubber bulb, arranged to permit of securely fastening the bulb to the barrel and to prevent the liquid drawn into the barrel from flowing into the bulb on inclining the syringe with the nozzle upward, the wall of the barrel having a minute air passage preventing the passage of the liquid.

ANIMAL TRAP.—E. E. Rodgers, A. W. Wenger and C. M. Rodgers, c/o A. W. Wenger, Bitem Bate Co., Warsaw, Ind. Among the objects of the invention are to provide a simple form of animal trap having one or more openings, which may be easily set without the danger of accidental release and the catching of the fingers, yet may be readily sprung, thereby insuring the successful operation of the device. The bait is so placed that it is independent of the trigger or releaser.

VENDING DEVICE.—A. B. Simon, 3636 Douglas Blvd., Chicago, Ill. An object of the invention is to provide a vending device in which packages or containers of different sizes may be used and in which an economy of space is effected so that the capacity of a vending machine of good dimensions is materially increased over the ordinary vending device. To prevent tampering the device may be locked by a concealed lock.

THREAD CUTTER.—L. G. Fritz and A. A. Herzberger, 385 E. Perry St., Tiffin, Ohio. This invention has for its object to provide a device preferably mounted upon a finger ring and having means for cutting thread, cord or the like, so held that there is no possibility of injury to the wearer, and having means for guiding the thread into the cutter.

FOUNTAIN PEN FILLING DEVICE.—A. T. Cross, Box 352, Wickford, R. I. The invention relates generally to fluid dispensing apparatus and more particularly to a simple form of hand-controlled dispensing arrangement to be applied to bottles. While the invention is capable of more or less general application, it is especially designed for the filling of fountain pens; it permits of manipulation with but one hand, while the other hand holds the fountain pen or other device to be filled.

STEMLESS SELF-CLOSING VALVE FOR HIGH PRESSURE TANKS.—E. E. Garland, 7 Anderson Ave., Port Richmond, S. I., N. Y. The particular object of the invention is to provide a stemless automatically self-closing valve for use in connection with high pressure gas tanks. Another object is to provide a valve which is of simple and rugged construction having few parts, and these conveniently arranged to permit of the removal or replacement of the safety means without interfering with the adjustment or setting of the other valve parts.

CRATE.—W. D. Woodruff, Belton, Texas. An object of the invention is to provide a crate especially adapted for carrying fruit, as for instance, peaches, tomatoes, berries and the like and for retaining said fruit in perfect condition without bruising or mashing, and may be stacked one upon the other without danger of collapsing.

METHOD AND APPARATUS FOR MOLDING OR CASTING ARTICLES OR INGOTS FROM MOLTEN METAL.—E. C. Wills, Box 163, Rahway, N. J. The invention has for its object to provide a method and apparatus for subjecting the cast articles while in a plastic state and in the mold to heavy pressure, for thoroughly compressing the molten metal in the mold to eliminate defects due to unequal expansion or contraction or from any other cause.

STILT.—R. J. Lynch, 84 Hunter St., Tamaqua, Pa. The invention relates to adjustable stilts and has particular reference to a step or foot support stamped or cut from a piece of sheet metal and adapted to be associated with a standard in such manner as to permit the ready vertical adjustment thereon and its positive securement in its adjusted position.

METHOD AND APPARATUS FOR SINKING PILING.—E. F. Estes, 1315 E. St., Lincoln, Neb. The invention contemplates a movable device for use in the hydraulic sinking of piling, and in the course of which operation the ries to be overcome a side pressure of the surrounding earth against the sides of the piling, that may be likened in part to that occurring in the excavation of a well when a cave-in is threatened.

PROCESS OF MAKING MONOLITHIC PAVEMENTS. — A. J. Parrish, Paris, Ill. The purpose of the invention is to provide a monolithic construction in which a base of concrete is provided, the bricks being set in the plastic concrete and pressed and then the spaces between the bricks filled with cement filler so that when the cement and concrete harden the whole forms a rigid structure not liable to disintegrate as in the case of a construction with sand cushions.

POLISHING WHEEL.—R. W. Putnam, c/o Cooley Wright Mfg. Co., Waterbury, Vt. The invention relates to wheels commonly known as ironing wheels, an object being to provide an arrangement of scroll on the under surface of the wheel which prevents the accumulation of abrasive or other material used for grinding or polishing the surface of stone, always tending to move such abrasive material toward the center of the wheel.

FIREARM.—O. F. Mossberg, 273 State St., New Haven, Conn. The general object of the invention is to provide a small firearm or pistol, and more porticularly a firearm in which the barrel with plural bores is stationary in the firing operation while the firing pin is revolved and its firing member, which is off the center of the pin, is caused to contact with the successive cartridges.

MOVING PICTURE THEATER.—E. W. Van Fleet, 622 Con. Realty Bldg., Los Angeles, Cal. An object of the invention is to eliminate the seats in proximity to the screen, which are undesirable on account of distortion and disorder induced in the optic nerve. The arrangement does not diminish the seating capacity of the house; the chairs are separated by a low partition placed transversely between two screens, one at each end of the theater, the patrons being seated facing the screen farthest from them, and therefore not less than half-way back in the house from the screen which they face.

COTTON GIN.—O. C. McBride, 215 E. Pierce St., Mangum, Okla. An important object of the invention is to provie a lint flue with means adapted to automatically operate to discharge the cotton from the lint flue when the pressure therein becomes excessive by reason of the cotton clogging in the lint flue due to the improper action of the condenser or to other causes. The device will not necessitate any special construction of gin or condenser.

COMBINATION TALKING AND MOVING PICTURE MCHINE.—P. T. L. Champeix, Menton, France. The invention relates to apparatus for presenting animated pictures formed by sections of an illustrated band or bands. An object is to provide a simple, efficient and inexpensive apparatus which can be easily synchronized with a phonograph through the medium of mechanical means which control the movement of the sections of the band forming the picture.

EXCAVATOR.—J. J. Warren, Genl. Delivery, Seattle, Wash. The object of the invention is to provide a simple and efficient excavating machine by means of which tunnels, trenches, ditches and the like may be rapidly dug with small expense of power, and the minimum of operators or workmen. A further object is to provide an excavator which can be easily handled, which is self-driven, and in which a single prime mover is used both for the operation of the excavator and its travel and maneuvering.

RECORD FILING CABINET.—R. McCart, Jr., 221 Mills Bldg., El Paso, Texas. This invention aims to provide a filing cabinet which at all times will present all of the records contained therein in plain view and in such manner that the title, which may be pasted or otherwise applied to the individual record container, may be read without stooping. A further object is to provide a filing device which will accommodate records of different sizes.

LABEL.—R. A. Van Clief, 190 Summer St., Buffalo, N. Y. A particular aim of the invention is to provide a poison label for bottles or other containers, the object being to provide a label constructed with luminous letters which can be readily distinguished at night, and by this means obviate accidents, such as are caused by persons in the dark. The label can be attached to any bottle, and is so constructed that the luminous paint is entirely protected from the air and will retain its luminous qualities.

ADJUSTABLE COMPASS DIAL.—H. T. Zeiner-Henriksen, Framnaesveien 12, Christiania, Norway. The invention has for its object an adjustable compass dial comprising two transparent disks rotably connected with each other, one of the disks being provided with a complete set of points, while the other disk is provided with a rectangular cross adapted to indicate the four main directions of the compass.

GUN CARRIAGE.—E. Rimailho, 12 Rue de la Rochefoucauld, Paris, France. The inventor has been granted two patents of a similar nature, the inventions having special reference to a gun carriage forming a complete artillery unit so constructed as to permit of traveling over all sorts of ground owing to its large bearing surface on the soil. It is particularly valuable on light or wet soil. The gun carriage consists essentialy of a chassis, having supports for the trunnions of the cradle of the gun and provided with rollers which roll over the chains actuated by driving wheels moved by an electric motor located on the carriage itself and fed by electric current furnished by a dynamo driven by a motor also located on the carriage.

READING GLASS HOLDER.—J. T. Spradling, White Plains, N. Y. The primary object of the invention is to provide a reading glass holder for use in connection with typesetting machines for the purpose of more clearly bringing out the manuscript of the copy from which the operator is working. A further object is to construct the device in such a manner that the glass is movable with respect to the manuscript copy, and is automatically returned to its starting point.

AGITATING DEVICE.—P. G. Campbell, Monolith, Cal. The primary object of the invention is to provide an agitating device to be used as a kicthen utensil for sifting flour and the like, by which better results may be realized in preparing flour for bread-making, particularly when the device is employed for mixing baking powder with the flour.

### Hardware and Tools

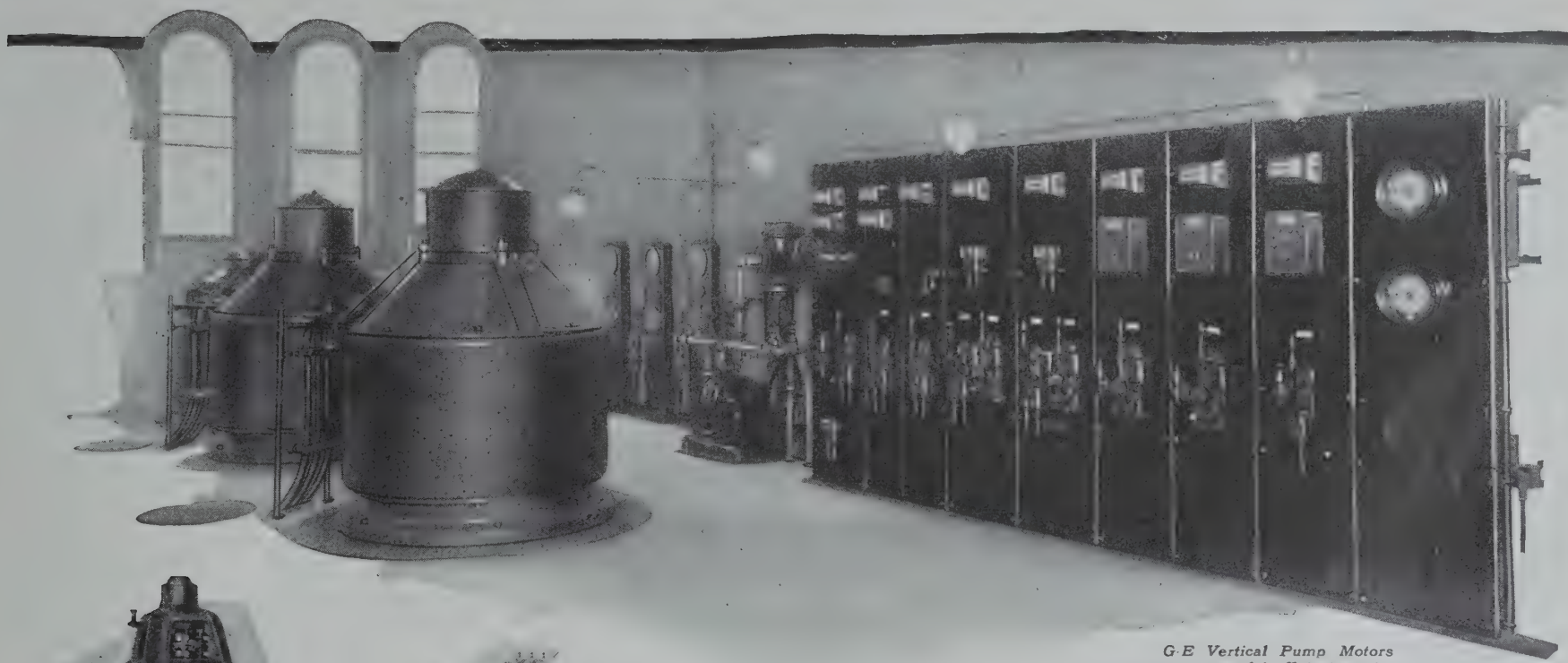
INSULATED TOOL.—J. A. Weaver, 238 So. Patterson Park Ave., Baltimore, Md. This tool is provided with a movable insulating sleeve carried by the contacting portion or blade of the tool which completely covers the blade in a manner to prevent injury to the operator, while at the same time it enables the tool to be properly used in fulfilling its function.

PUNCHING SHEARS.—E. E. Cornell, 2714 Rutger St., St. Louis, Mo. The object of Mr. Cornell's invention is to provide a simple economical and effective hand-operated implement for slotting paper, card board, sheet metal and the like. The implement has a shearing action and is capable of ready adjustment in respect to the length of the slot to be cut.

CASEMENT ADJUSTER.—C. J. Hagstrom, Maple Ave., Glen Cove, N. Y. This casement adjuster is readily adaptable to any casement

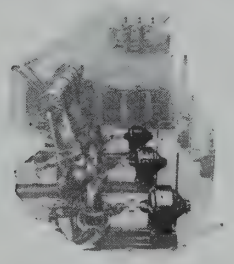
*(Continued on page 436)*

*The margin of profit in many industries largely depends upon the efficiency, dependability, and low upkeep cost of machinery used*

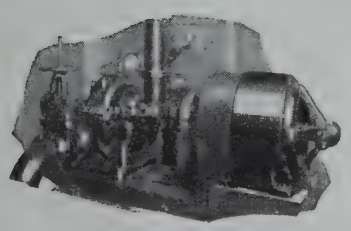


*G-E Vertical Pump Motors give powerful, efficient service in this water pumping station.*

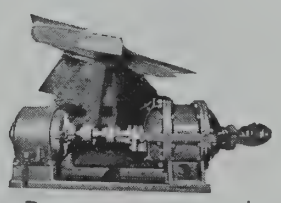
*Vertical Motor direct drive for centrifugals or pumps.*



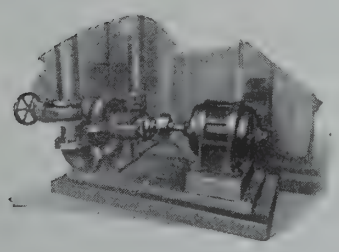
*Motors direct connected to centrifugal pump—6000 gallons of water per minute.*



*Protect your industry with motor-driven fire pumps.*



*Dependable operation of motor-driven pump under severe conditions in mining.*



*Motor driving battery supply pump in sugar mill.*

*Widespread developments in irrigation through use of motor-driven pumps.*

## *Electrically driven pumps raise the margin*

PUMPING costs receive careful scrutiny in the economical management of many industrial properties. Consideration of the most satisfactory solution of the varied problems involved leads to electric drive in which G-E Motors and attending equipment are specified.

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## RECENTLY PATENTED INVENTIONS

(*Continued from page 434*)

window, door, or other swinging object and is arranged to hold the window or door frictionally, but substantially, at any desired adjustment with respect to the wall.

EDGE TRIMMER.—W. H. BROWNING, 16 Cooper Sq., New York, N. Y. The invention relates to garden tools; an object is to provide a device which can be operated along the edge of a walk or around the edge of a flower bed or the like to cut the grass which hangs over or is pressed down by the mower in cutting the lawn.

LOCKING DEVICE.—G. W. BURTON, 1471 Broad St., Providence, R. I. The invention has reference more particularly to a locking device which embodies some of the characteristics of a nut lock, although its salient features are in no way represented by a nut lock except that the device is intended to be associated with a bolt or spindle which is threaded at one end, and in which such threaded end is received by the lock device, with the device confining and locking a structure on the bolt or spindle.

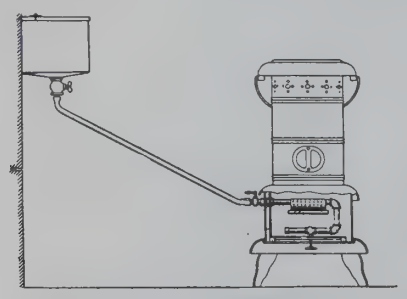
EXPANSION REAMER.—S. H. HUMPHREY and F. H. KORFF, 48 Academy St., Poughkeepsie, N. Y. The invention relates more specifically to means for permitting the convenient and ready adjustment of reamer blades. One of the objects is to provide an adjusting means which is inexpensive to manufacture, simple and rugged in construction and so constructed and arranged as to be readily adjusted to obtain a definite adjustment of the cutting edges of the tool.

MICROMETER GAGE.—T. SHAW, Woonsocket, R. I. This invention relates to measuring instruments, and has for its object the provision of a micrometer gage embodying in its construction indicating wheels moved by rotary movement of the handle and carrying indicia visible through sight openings, these indicia indicating the dimension of an object being measured directly and without the troublesome use of a vernier scale.

ADJUSTABLE CUTTER.—F. H. KORFF and S. H. HUMPHREY, 48 Academy St., Poughkeepsie, N. Y. Among the objects of this invention is to provide an adjustable cutter which is simple and strong in construction, inexpensive to manufacture and which is so constructed as to be conveniently adjusted to different predetermined sizes. A further object is to provide a micrometer adjustable cutter having indicating marks thereon so that the effective cutting edges of the tool may be adjusted to a predetermined size.

### Heating and Lighting

OIL BURNING HEATER.—D. SEINIGER, c/o Standard Kertogas Co., Middletown, N. Y. The object of the invention is the vaporizing of kerosene into gas, the device being constructed of materials which obtain complete combustion. Its purpose being the replacement of burners,



AN ELEVATION WITH HEATER BODY PARTLY BROKEN AWAY, AND IN SECTION

using oil, gasoline, distillate or gas, for producing heat, power or steam, and its application is to heater bodies, such as room heaters, water heaters, cooking ranges, small hot water boilers and machines requiring gas or steam.

DEVICE FOR CONSERVING FUEL.—W. O. WOOD, Riverside, R. I. The invention relates to a device for employing the heat contained in the flue gases of stoves, furnaces and boilers. An object is to utilize air heated by the flue gases for heating purposes. A further object is to use the heat contained in the flue gases to pre-heat air supplied to the grate of the heating unit.

INDEPENDENTLY DETACHABLE UNDERSHADE FOR LIGHT STANDARDS.—M. Y. SUGIMURA, 32 Union Sq., New York, N. Y. An object of the invention is to provide an under lamp shade which serves as an indirect light reflector and also softens the direct downward glare from the source of illumination positioned above, and to permit such a shade to be independently removed without disturbing the assembly of the lighting fixtures.

HEATING MEANS.—W. W. LILLARD, c/o E. J. King, 141 Howard Terrace, Leonard, N. J. The object of the invention is to provide a heating means for heating monolithic structures such as street gutters and sidewalks, to melt the snow, and thus rendering it serviceable for heating floors of factories, schools or other buildings. The heatig medium can also be used in incubators and brooders, and can also form individual portabe heaters for use as bed warmers, foot warmers and the like.

OIL BURNER.—A. T. TIMOSCI, 668 Willis Ave., N. E., San Jose, Cal. This invention relates to oil burners, and has for its object to provide a small and efficient burner of the character specified, wherein the oil is sprayed on to a heated plate by means of fluid under pressure acting in the manner of an injector.

### Machines and Mechanical Devices

CUTTER HEAD.—F. P. MILLER, c/o McCroskey Reamer Co., Meadville, Pa. The invention relates to cutter heads such as are used in milling machines; its object is to provide cutter heads whereby the cutting tool is firmly drawn into position in its seat and is securely fastened therein without the use of set screws or similar devices. Another object is to permit of quickly fastening the cutter in place and to allow of removing it whenever desirable.

PIPE PULLER.—S. ROBICHAUX and C. PAGGI, 3303 Montrose Blvd., Houston, Texas. This invention provides an improvement in pipe pullers and has for its object the provision of mechanism for use in connection with the pulling mechanism for pipe casings of wells of the character described in a previous patent (No. 1,280,850) granted to the same inventors. The present mechanism is used for gripping the pipe and threading or cutting the same as it is pulled.

MACHINE FOR BURNING IN BEARINGS AND LIMBERING UP MOTORS.—A. O. WHITE, High Point, N. C. The general object is to provide a machine for burning in bearings and limbering up motors and more particularly to an arrangement for rotating the crank shafts of automobile motors. A further object is the provision of an arrangement adapted alike to motor blocks removed from their supports, as well as to the crank shafts of automobiles complete and ready for operation.

SHEET GUIDE FOR FOLDING MACHINES.—E. SCHEICK, 17 Trinity Place, Arlington, N. J. The invention relates generally to a feeding device for folding machines and is particularly adapted for use in feeding relatively long and narrow strips of paper, to the folding rolls, on what is known as the Cleveland folding machine, but can be used in other machies employing a sheet feed mechanism and where an accurate fold is desired.

ROLLER BEARING AND METHOD OF MAKING THE SAME.—H. J. JONES, 72 Floyd St., Belleville, N. J. This invention relates to the construction of roller bearings as distinguished from ball bearings, and has particular reference to the form and method of making the rollers constituting the antifriction elements of such bearings. Among the specific objects is to provide a roller in which the grain or fiber of the metal extends as nearly as possible parallel to the direction of rolling action, whereby the likelihood of chipping, flaking, or crushing of the rollers will be reduced to a minimum.

TUMBLING APPARATUS FOR FURS.—B. & S. FRIEDMAN, 232 Keap St., Brooklyn, N. Y. The object is to provide a tumbling apparatus for softening furs or pelts, arranged to insure an intense tumbling action with a view to quickly soften a large number of furs simultaneously and without danger of injuring the furs. Another object is to permit the operator after the tumbling action is completed to quickly and efficiently separate the furs and the sawdust or other tumbling material used.

BOBBING AND SPINDLE CONNECTION.—C. NORDELL, Gilbertville, Mass. An object of the invention is to provide a bobbin holding mechanism which depends on centrifugal force to form a friction connection between the revolving shaft and the bobbin. A further object is to provide a device of the character stated which will be extremely simple in construction and durable in use.

MECHANICAL MOVEMENT.—G. MULLER, 103 Schley St., Glendale, L. I., N. Y. The invention relates to mechanism for converting reciprocating motion into intermittent rotary motion; its object is to provide a mechanical movement especially designed for intermittent feeding purposes and which is simple and durable. Another object is to reduce the wear of the working parts to a minimum and to insure proper functioning of the parts without danger of binding or sticking.

SUCTION CONTROLLING DEVICE.—L. J. DELLERT, 176 Russell St., Brooklyn, N. Y. This invention relates to grinding and polishing machines having a plurality of grinding or polishing wheels provided with dust receiving hoods connected by branch pipes with a main suction duct connected with a suction fan to produce suction and carry off the dust and other particles, arising by the operation, to protect the workmen against inhaling the particles.

CLOCK.—C. H. ANDERSON, address H. R. Kleinbach, c/o Title Guarantee Trust Co., Los Angeles, Cal. This invention has for an object to provide a construction wherein the time indicating means is arranged so that a number will indicate the hour, and an oscillating point the minutes. A further object is to provide means which is capable of being connected to ordinary clock mechanisms now in common use.

POST FOR SCALES.—G. G. and E. L. VOLAND, 48 Trinity Place, New Rochelle, N. Y. The invention has for its object to provide a post for scales, having means to indicate when the post is in true vertical position. As a means of determining the vertical position of the post a plumb is provided which is secured to the transverse member of the scale, it being possible to compare the position of the plumb relatively to marks on the base of the scale.

METHOD OF TREATING PEAT.—W. W. BLAIR, 141 Milk St., Boston, Mass. This inventor has been granted two patents of a similar nature which relate to a process for the treating of peat for fuel purposes. Among the objects of the inventions is to provide a machine for macerating and blocking the peat. The two processes of treatment consists of macerating the freshly dug peat and pressing the same into blocks, and compressing unmacerated peat into blocks, drying the blocks and then immersing the blocks in an oil bath to impregnate them with a fuel oil.

### Musical Devices

PLAYER PIANO ACTION.—W. J. WODRASKA, 1290 1st Ave., New York, N. Y. Among the objects of the invention is to provide a player piano action of the most compact and simple construction adapting it for cheap manufacture. Another object is to provide for each pneumatic or pair of vertically alined pneumatics a single and detachable valve block, the same providing for easy inspection or repair of any valve or associated parts without disturbing any of the other valve mechanisms. A further object is to provide valves so balanced as to be most responsive to the pneumatic operation.

DISK RECORD HOLDER.—G. E. FOSS and H. G. JENSEN, c/o G. E. Foss, 1638 N. Avers Ave., Chicago, Ill. The invention relates to holders for disk phonograph records. An object is to provide an inexpensive holder in which the records may be held compactly, means being provided for identifying any record and for moving it forwardly, whereby the record may be easily withdrawn. A further object is to provide a holder which is adjustable so that records of various sizes may be held.

RECORD CABINET.—E. C. FREMAUX, Rayne, La. The invention relates to that class of cabinets which are adapted to hold disk talking machine records. The primary object is to provide a simple and practical cabinet which

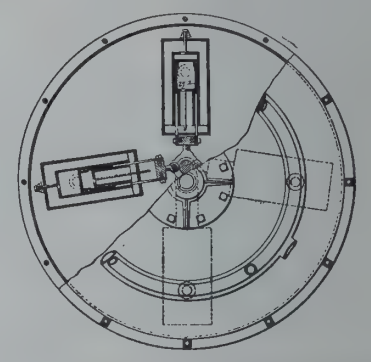
AN ELEVATION OF THE DEVICE

will insure the records being kept in their proper holders, each compartment having an individual locking device whereby the records may be selectively removed, and means for automatically and collectively locking the remainder of the compartments upon unlocking one of the compartments; when a record is removed it will be impossible to replace it in the wrong compartment.

FREE SOUNDING BOARD.—G. VIRZI, 341 E. 124th St., New York, N. Y. This invention may be applied to sounding boards of all kinds, especially all sorts of stringed instruments. The invention comprises the combination of a main sounding board, an auxiliary a character to prevent leakage between the two to hold the auxiliary board in definite spaced relation to the main sounding board, the securing means including a rib secured to one of said boards throughout its length, and having at least one integral extension to which the other sounding board is attached.

### Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE.—A. P. HARDWICK, Box 231, Chowchilla. Cal. An object of this invention is to provide a double acting four-cycle internal combustion engine embodying as one of the principal features a reciprocating piston capable of compressing charges on both sides of the head and the



A SIDE ELEVATION OF THE CASING PARTS BEING BROKEN AWAY

cylinder heads between which the piston reciprocates. Another object is to provide a pivotal mounting for the relatively fixed cylinders, through the medium of which the cylinders may oscillate to accommodate the positions of the reciprocating piston without the use of a wrist pin.

ROTARY ENGINE.—C. MULINEX, Tolley, N. D. This invention is adapted for embodiment in either an engine or a pump and is adapted to employ any suitable motive fluid such as steam, air, or gas. The general object is to provide for the automatic sliding of the pistons to the power position and return without providing a side pressure thereon such as would cause binding of the pistons in the rotor, and to provide a construction of a character to prevent laekage between the rotor and starter.

ENGINE.—E. SARJENT, Kingfisher, Okla. The invention relates more particularly to a compound engine in which the otherwise waste gases are utilized to drive an expansion engine, which later may be utilized as a starting means for the internal combustion engine, a portion of the exploded gases from the internal combustion engine being stored in a receiver and supplied to the expansion engine as desired, the supply being under control.

VALVE EXTRACTOR.—E. T. LIESS, P. O. Box 512, Huntington, N. Y. The particular aim of this invention is to provide a device adapted for the extraction of valves from an internal combustion engine. A further object is to provide a device which can be made of any suitable material, preferably high grade steel, which may be made very light and strong, of cheap construction and easy to apply.

### Railways and Their Accessories

TRAIN COUPLING.—J. B. HOLLAND, 850 W. Fayette St., Baltimore, Md. An object of the invention is to provide a car coupling in which the brake and signal lines are operatively connected and combined in such a way that when two of the couplings are joined, as between two connected cars, a fluid tight connection will be established at once, such connection remaining firm regardless of the relative movement of the coupling members.

PULVERIZED FUEL BURNING DEVICE.—J. DICKSON, U. S. Natl. Bank Bldg., Vancouver, Wash. The invention relates more especially to devices for enabling locomotive engines to make use of pulverized fuel. An object is to provide a device by which pulverized fuel may be introduced into the combustion chamber of a locomotive by means of a stream of heated air so that the fuel is substantially consumed, leaving a relatively small amount of ash and giving a maximum quantity of heat.

(*Continued on page 438*)

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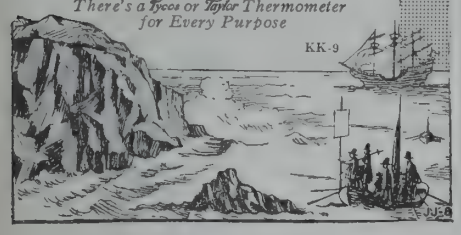


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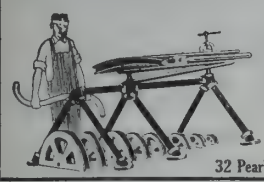
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## Making the Hetch-Hetchy Dam Itself

(*Continued from page 422*)

The tunnel level is really some distance from the very bottom, being at a depth of 575 feet. The excess depth of the shaft provides for a special pocket equipped to load skips by gravity and for a pumping sump. Another shaft providing for access to the tunnel is known as the Second Garrotte shaft. Its full depth is, or will be, about 820 feet, though the tunnel grade is only 756 feet below the surface.

In driving the headings, a round of 18 to 24 blasting holes is provided. When these are exploded, an advance of about 5 feet is made. The excavation is made in full section at single operations, so that no bench is left for later removal. The tunnel is ultimately to be lined with concrete. The minimum thickness of the lining is 6 inches. The cross-section is of horse-shoe shape, the toe of the shoe being naturally at the top.

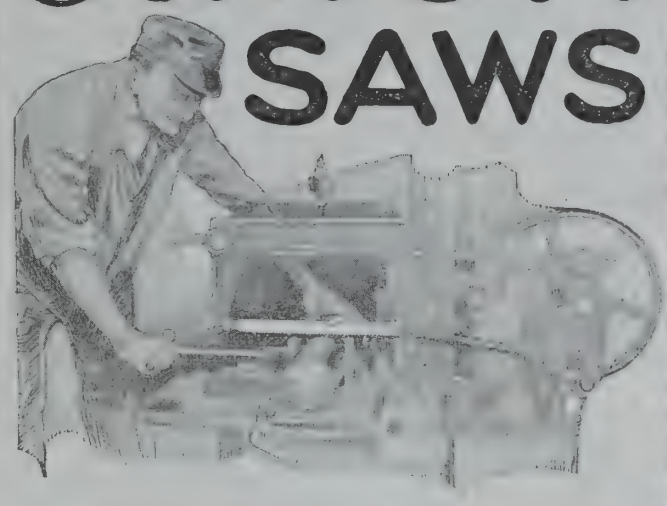
The power house which is located at Early Intake and whose pressure water comes from Lake Eleanor operates under a head of 346 feet and has a capacity of 4,000 hp. The use of timber flumes as part of the conduit which brings water from the diversion dam on Cherry River seems to have been dictated largely by the consideration that upon certain very precipitous mountain sides it would have been exceedingly expensive to excavate for a concrete canal. Later on, when conditions are more favorable, it is proposed to replace the flumes by tunnels, and to provide the necessary cross-cuts. The tunnel work may then be done without interruption to the operation of the plant. The manner of constructing the flumes on the steep mountain sides is of interest. A certain amount of excavation had to be done in order to provide for the support of the footings. This was carried to bed rock. The under part of the framing was put in place and the floor laid. A track was constructed of wooden rails and push cars loaded with lumber were shoved along on it. An immense amount of lumber was consumed—upward of 1,300,000 board-feet. The city cut this lumber at its own saw-mill, from which it went to the points of use.

The steel penstock is 42 inches in diameter. From the forebay down to the turbines which it serves, it is 530 feet long. The thickness of wall varies from 3/16 inch to twice as much. Naturally, the heavier wall is used in the lower sections, where the hydrostatic head runs up to a maximum pressure in the neighborhood of 150 pounds per square inch. The wheels are Pelton-Francis turbines operating in vertical planes. They are direct-connected to their respective generators. The current is developed at 2,300 volts, but is stepped up to 22,000 for transmission purposes. The lines are estimated to extend 19 miles on the west and 14 on the east. There are three units, although the plans called for the output of but two, the third being reserved for emergency use. The transmission line to the west lies in the same vertical plane with the tunnel underneath.

The Early Intake power house performed a certain amount of service during the fuel shortage of the Great War. It began operation as early as May, 1918, at a time when its full capacity was not required for aqueduct work. In September, the Power Administrator ordered that the transmission line be connected with that of the Sierra & San Francisco Power Company for the purpose of supplying surplus energy at points served by this commercial concern. In three days after the date of the formal order, the connection had been made and the delivery of surplus energy begun. In fact during the fiscal year 1918-1919, of the total output of 18,687,400 kw.-hrs., 13,505,621 kw.-hrs. were delivered for use other than that connected with the aqueduct.

The muck handling machine already referred to is a self-propelling apparatus.

SIMONDS
SAWS



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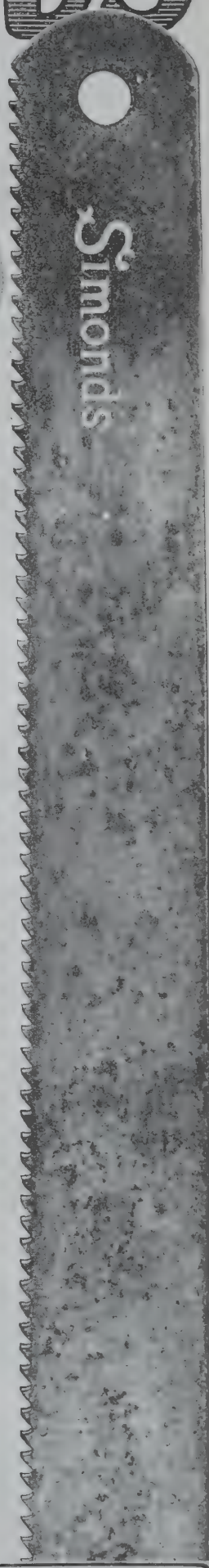


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## RECENTLY PATENTED INVENTIONS

(*Continued from page 436*)

CUT-OFF RELIEF VALVE FOR AIR BRAKES.—E. P. CLAUSS, 26 Maple St., Lyons, N. Y. This invention has for an object to provide a construction which will act as an angle cock substantially in the usual manner, but will act to bleed the system when turned off. Another object is to provide an angle cock which will bleed the system when turned off both in front and rear of the cock, and to be arranged so as to be unlappable.

RAIL.—N. I. WOOLSEY, 5474 Asbury Park Rd., Huguenot Park, S. I., N. Y. The invention relates to railroad and street car tracks; its object is to provide a rail arranged to permit of quickly replacing a worn out head by a new one without removal of the web and base from the track. Another object is to provide a protected passage for the electric conductor, and to prevent spreading of the rails.

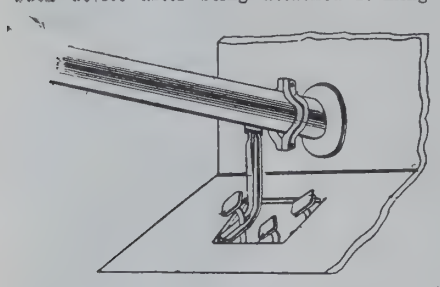
### Pertaining to Recreation

PUZZLE.—V. A. HLASKO, 36 Holland Park, London, England. The primary object of the invention is to provide a toy such as are commonly known as puzzles in which a plurality of element of different sizes are movable relatively to each other to position them according to their value, it being understood that each of the elements is given a different value.

### Pertaining to Vehicles

LOCKING DEVICE FOR AUTOMOBILES.—J. P. GERAGHTY, 493 Grove St., Jersey City, N. J. Means are provided within the hood enclosing the motor to prevent starting the motor and the hood is locked to prevent unauthorized persons from gaining access to said means. A plurality of devices are provided for rendering various parts of the motor inoperative so as to prevent even experts from stealing the car.

LOCK FOR AUTOMOBILES.—C. W. NIXON, 400 Bourbon St., New Orleans, La. The invention relates to locks for automobiles to prevent theft of the machine. An object is the provision of a locking device, which effectively locks a clutch pedal in neutral position, such device after being attached forming an



A FRAGMENTARY VIEW OF A FORD CAR WITH LOCKING DEVICE APPLIED

integral part of the machine, and constructed to prevent the prying or bending apart of any part of the device, in an attempt to remove the same from the pedal.

AUDIBLE ALARM FOR VEHICLES.—L. H. MORGAN, c/o The Ellengton Apln., Cleveland, Ohio. Among the objects of the invention is to provide means whereby when a vehicle is left standing unguarded it may be so adjusted that it cannot be moved without authority without the sounding of a loud alarm. The object is to provide an alarm device which may be easily applied to any standard vehicle in which there is a rotary shaft.

WIRE WHEEL.—T. A. BOWERS, 64 Sudbury St., Boston, Mass. An object of this invention is to so temper and crimp the spokes as to materially increase the strength of the wheel by taking up all internal stresses set up in the spokes under service conditions, the purpose being to make the wheel resilient and to increase its ability to withstand shocks and strains.

VEHICLE ROUTE INDICATOR DEVICE.—E. SIEGEL, c/o Siegel Bros., 154 Nassau St., New York, N. Y. Among the objects of the invention is to provide a road indicator by means of which road directions and land marks over a relatively great distance may be provided in a compact space, the mechanism being so arranged that the road characteristics or land marks may be shown upon a relatively large scale, and before the said marks are actually reached whereby the driver will have ample warning of same.

STAND.—E. H. KELLEY and G. A. STEWART, JR., South Brownsville, Pa. This invention has for its object to provide a stand especially adapted for use in repairing and testing engine cylinder blocks, particularly of the Ford type. The invention comprises a base, having at one side legs, and at the other side wheels for supporting the base, the base and legs being of angle material.

SIGNAL FOR MOTOR VEHICLES.—E. P. GOODCHILD, 2116 Monroe St., Spokane, Wash. Among the objects of the invention is to provide a signal which will indicate to following vehicles, and to those in front, the intention of the driver in regard to turning or stopping. The signal is in the form of an outstretched hand, adapted to be normally held in a casing, but extended and withdrawn at will by the driver.

TANK LOCK.—F. H. RUNDALL, 343 Peary St., Fall River, Mass. The invention relates more particularly to means for locking the caps or plugs of gasoline tanks on automobiles, an object being to provide a device which will prevent the theft of gasoline while tre car is standing in garages or elsewhere, as the cap can be removed only by an authorized person with the proper key.

TEMPERATURE INDICATOR FOR ENGINE WATER CIRCULATION.—G. P. PITKIN, Bergenfield, N. J. The invention provides improved means for supporting a thermometer on the dashboard of an automobile, airplane or other similar device. The thermometer is in direct communication with the water circulating through the cooling system so that the operator can see at all times the temperature of such water.

DIFFERENTIAL.—G. W. WILKIN, Box 962, Grangeville, Idaho. The primary object of the present invention is to provide a very simple differential gearing which will transmit power to all four wheels of a vehicle and which will permit of the turning or rotation of all four wheels independently of each other. Under normal conditions it will transmit a maximum of driving power to each wheel.

PNEUMATIC WHEEL.—E. B. HUDSON, 519 Crawford St., Middletown, Ohio. This wheel is so constructed as to eliminate punctures, blow-outs, and rim cuts. The pneumatic element is not placed at the periphery of the wheel but is introduced between the wheel and the hub while a solid rubber tire is mounted on the rim of the wheel.

SPRING WHEEL.—W. A. BURGER and W. GROSS, San Francisco, Cal. An all metal spring wheel is provided by this invention which is designed to take the place of a pneumatic tired wheel. The rim is composed of a series of movable sections which are cushioned by radially extending springs. The tension of these springs may be varied at will.

CONVERTIBLE AUTOMOBILE BODY.—J. J. MCGUIRE, 21 Sherman Ave., Yonkers, N. Y. The object of this invention is to provide a new and improved convertible automobile body arranged to permit of its being converted into a limousine, runabout, open car body or partly open car body. Another object is to provide sleeping accommodations in the limousine body.

OIL CUP—L. H. WILLIAMS, c/o R. L. McDonald Mfg. Co., Box 1177, St. Joseph, Mo. The invention relates to a form of oil cup that is adapted to be attached directly to a leaf-spring of an automobile whereby a lubricating oil is fed as needed between the leaves composing the spring. A further object is to provide a device that can be quickly attached or detached without the necessity of using any tools.

AUTOMOBILE COWL ATTACHMENT.—J. H. COFFMAN, 201 Waverly Way, Atlanta, Ga. This invention has for its object the provision of a cowl construction whereby to provide a gutter located beneath the juncture of the hood with the cowl whereby to prevent water from dropping down onto the coil box terminals and ignition wires connected therewith.

### Designs

DESIGN FOR A STAND.—W. F. FAAS, Cleveland, Ohio.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

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One of the sizes has a weight of 18,500 pounds and a length of 22 to 26 feet. It may be driven by a 20-hp. motor or by compressed air. This machine is said to have a capacity in loose material equal to the loading of 200 to 300 tons per day of 8 hours. Naturally, in rock and in the confined space of a narrow tunnel, the capacity would be much less. The crew consists of three men—one to operate the handling feature, one to shift the cars, and one to couple up cars. This apparatus may be mounted on a track or it may be equipped with traction "wheels." It delivers to cars immediately to the rear or to cars alongside. The shovel which recovers the spoil and loads it on to a short conveyor is a curious device. It is driven by a crank which rotates continuously in a single direction and which is carried on a curved track. It may move downward, upward or forward, and may be turned to discharge its contents on to the aforesaid conveyor. In the big machines the shovel goes through its cycle 13 times per minute. With machines of this and similar types the question of successful performance of the duties required is only one part of the problem. It is highly important that the design be sufficiently simple and the construction sufficiently rugged to avoid frequent shut-downs and expensive repairs. In the past there has apparently been a good deal of difficulty in designing and building machines for cutting and mucking in tunnel headings that fulfil all the requirements.

## A Magnetic-Proof House for the Workers

(*Continued from page 423*)

instruments and appliances for the investigational work is entirely non-magnetic in character. The heating is provided by a central steam-heating plant in the main laboratory about 250 feet distant. The radiators are of copper tubing. The steam, return, gas, hot and cold water, drain and air pipe lines and lead-encased electric cables are hung in a concrete tunnel sufficiently large to allow alterations and additions. All of these lines and their mountings are non-magnetic in character within the building and for a distance of forty feet outside. The laboratory tables and galvanometer mountings are of carefully selected soapstone free from magnetic impurities. Provision is made for three alternating current circuits and fourteen direct current circuits between the laboratory and the main building.

The plans, design and details of the Experiment Building were prepared by J. A. Fleming of the Department Staff and the work carried out under his direction.

## The Romance of Invention—XVIII

(*Continued from page 424*)

met calculates that the saving amounts to three per cent of the total capacity of the ship, which saving is accompanied by the further advantages of saving in weight; for electric drive units weigh less than any other type of drive, without consideration of the fifty or sixty tons of weight saved in the elimination of the usual propeller shaft, bearings and gear.

Personally, Mr. Emmet is a fluent talker upon subjects which interest him, possessed of a viewpoint almost wholly scientific, and with a modesty of thought about his work which is very pleasing. From childhood he had a love for mechanical things and as a boy did much carpentering and other mechanical work. He states that he had "no remarkable skill or facility, but the enterprise to begin difficult jobs and the persistence to carry them through."

Much of the faith and initiative necessary to start and carry through important new work has been his, in addition to a large amount of invention and much thought and experimentation both as to proportion and general economic characteristics and as to details of construction. Of his work with the General Electric Co. he says: "In all my work at Schenectady I have held to engineering and avoided as much as possible executive activities, but have had to do much in organization and direction of new undertakings and also in selling new things—which can generally be accomplished by those who have complete faith based upon positive knowledge. I have always realized that there was a great number of possible undertakings in which the energies of a good engineer would bear good fruit, and I have generally had many such in view; but I have confined my best efforts to a few important campaigns which in my opinion conduced to large developments of the electric art.

"Since I have been in the manufacturing end of the electric industry, I have mainly devoted my energies to four large undertakings. The first of these was the development and promotion of electric distribution by alternating currents, a movement in which many were engaged but in which I planned, and to a large extent executed, some of the most important initial steps. This activity lasted from 1894 to 1905.

"My next important undertaking was the Curtiss turbine development, which extended from 1900 to about 1912, when I began to leave its principal direction to others.

"My third important activity was the electric propulsion of ships. This, as applied to warships, extended from 1909 to 1919 and the campaign is at present being extended to merchant ships.

"My fourth important activity has been my mercury-vapor process, which has been worked upon since 1913 and has not yet reached a state of commercial development. This process is entirely my own work, every detail of conception, experimentation and actual design has been worked out by me, with practically no help but that of my personal assistants and draughtsmen working in my office. Very important demonstrations have been made, a large commercial application is now being begun, and I believe that the process will develop very great importance."

Mr. Emmet has more than a hundred patents to his credit, ranging over the whole field of electrical and steam engineering. He has just received the Edison medal, a distinguished honor which his conferes in electrical and steam engineering circles say has been well and honestly earned.

## A Mechanical Age for the Farm

(*Continued from page 426*)

oratory, farm lighting laboratory, farm hydraulics laboratory, and lecture room. There is a special building at the rear of the main building for the tractor testing work.

A great number of the students who take these courses go back to the home farm, but those who aspire to the most advanced work often plan on entering the agricultural engineering field as professional men. There has been a shortage of men who are professionally trained in these lines and the large implement and tractor companies are on the alert for the best talent. It was only a comparatively few years ago when 100 students taking work in agricultural engineering was almost an epoch-making event but there are now over a thousand a year taking such work at the University of Nebraska. Needless to say, not all of the students take all of the courses but agricultural engineering has come to be recognized as one of the branches to be learned by the scientific farmer. No better illustration of the great demand for mechanical information on the farm can be gained than the fact that the two or three letters of inquiry a week have now often passed the 500 mark.

But the tractor testing probably represents the most important piece of work attempted. The tractor purchaser is not

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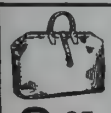

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in a position individually to make tests to show whether or not a tractor comes up to the claims made for it. One of the difficulties in purchasing a tractor has been the fact that horse-power ratings have not always been true indications of tractor capacity. Some manufacturers have overrated their tractors, others have underrated. The result has been that farmers have sometimes secured tractors too large or too small for the work to be done, and have also secured machinery too large or too small for the tractor. The results of tractor tests under the new tractor law will give tractor purchasers the information they need regarding horse-power capacity of tractors.

Under the law each tractor manufacturer must deliver his tractor to the university and a temporary permit is issued until the test is completed. One provision of the law is that the manufacturers cannot use the results of the tests for advertising purposes unless the complete results are also published, thereby preventing them from telling only the good points of their tractor in the test. The following is a complete list of the tests that the tractors are obliged to pass:

1. Drawbar work at one-third load to full load for 12 hours. This test gives opportunity for the tractor to limber up.

2. Brake horse-power test at rated load and rated speed for two hours. This test will show whether or not the tractor will carry its rated load on the belt; also show fuel consumption at rated load.

3. Brake horse-power test at load varying from maximum to no load with all engine adjustments as in test (2) for one hour. This will show fuel consumption and speed-control on varying load.

4. Brake horse-power test at maximum load for one hour with governor set as in test (2) and carburetor adjusted for most economical operation at one-half load. This test will show fuel consumption at one-half load.

6. Drawbar horse-power test at rated load for ten hours. This test will be made on a half-mile cinder track and will show whether or not the tractor will carry its rated drawbar load continuously; also shows fuel consumption on drawbar work.

7. Maximum drawbar horse-power test. This test will be a series of short runs with an increase of load for each run until the engine is overloaded or the drive wheels slip excessively.

8. Miscellaneous. This may include investigation of work on inclines, turning radius, effectiveness of brakes, or any feature of the tractor which may seem to require special observation.

9. Tractors will be under observation for endurance throughout the complete test as outlined above.

A half-mile cinder track has been constructed for the tractor drawbar tests. A special dynamometer car ras been built on a tractor chassis, with an electric generator in place of the engine. A tractor dynamometer gives the record of the drawbar pull, distance traveled and time.

To make the tests of the tractor work on the belt an electric dynamometer has been installed in a building erected for that purpose. Fuel consumption is recorded by drawing the fuel from a tank mounted on a scale. The entire tests are passed on by a board of three engineers. Needless to say, all the operating of the tractors is done by the university, although the company may have a man present.

It was a noteworthy fact at the dedication of the new building that several of the speakers called attention to the somewhat primitive agricultural implements that they were compelled to use as boys on the farm. The last thirty years have seen marvelous strides in the development of factories, and the next thirty years will see the development of some wonderfully efficient farms. In truth, the farm is a factory and the farmer is still entitled to all the labor-saving devices that can be mobilized for his aid.


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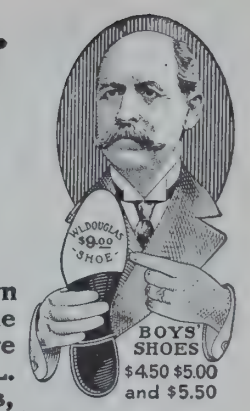


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3. Each essay must be typewritten, and identified with a pseudonym. The essay shall bear a title and the author's pseudonym *only*, and must be enclosed in a plain sealed envelope likewise bearing this pseudonym. In the same package with the essay must be sent a second plain sealed envelope, also labelled with the pseudonym, and containing a statement of the name and address of the contestant, the pseudonym used, and the title of the essay. It is necessary to follow these instructions implicitly, in order to guard against confusion in opening the envelopes and assigning the pseudonyms to their proprietors, especially in view of the possibility that two of the contestants may employ the same pseudonym. The envelopes should be sent in a single package to the Einstein Prize Essay Editor, SCIENTIFIC AMERICAN, 233 Broadway, New York.

4. All essays must be in the office of the SCIENTIFIC AMERICAN by November 1st, 1920.

5. The Editor of the SCIENTIFIC AMERICAN will retain the small sealed envelopes containing the competitors' names and addresses, which will not be opened until the competitive essays have been passed upon and the winning essay selected.

6. As soon as the judges have selected the winning essay, they will notify the Editor, who will open the envelope bearing the proper pseudonym and revealing the competitor's true name. The competitor will at once be notified that he has won, and his essay will be published in an early issue of the SCIENTIFIC AMERICAN.

7. There shall be but one prize, of FIVE THOUSAND DOLLARS, to go to the author of the best essay submitted.

8. The SCIENTIFIC AMERICAN reserves the right to publish in its columns, or in those of the SCIENTIFIC AMERICAN MONTHLY, or in book form, any of the essays which may be deemed worthy of this. Aside from such rights, the essays shall remain the properties of their authors; but no manuscripts can be returned.

9. The Committee of Judges will consist of Professors Leigh Page of Yale and E. P. Adams of Princeton. In the event that they are unable to agree on the best essay, the Einstein Prize Essay Editor will cast the deciding vote.

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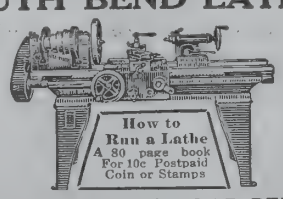


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## Extracting Oil by Electrolytic Action

(*Continued from page 428*)

rators. The solid matter, when pressed, dried and granulated, makes excellent feed for chickens and hogs, containing from 60 to 70 per cent protein, or it can be used as a fertilizer. The entire process is an odorless one, and only a very limited amount of labor is necessary to keep a plant in operation. The installation at Gloucester has 12 coils or cells in the electroytic unit, but even so the equipment is capable of turning out 50 barrels of cod liver oil in eight hours, each barrel holding 400 pounds.

Excellent results have been realized in handling entire fish when suitably cut up or ground to make it possible, after admixture with the saline electrolyte, to pump the stuff through the extracting unit. No matter whether the flesh of shark, menhaden, herring, etc., be used, the quality of the oil and the quantity are both much superior to the yields secured by other means. As might be expected, the Roger's-Bennett system is showing its flexibility in dealing with butcher's trimmings and the better grades of fat. By the best practice in vogue the tallow yield does not exceed 45 per cent, while the electrolytic unit gives 60 per cent and the oleo recovery reaches 90 per cent by the newest apparatus as against a maximum of 82 per cent by up-to-date commercial equipment.

These gains in output are likely to pay handsomely. Just how much so can be grasped from a report issued by the Bureau of the Census covering the three-month period ending June 30 of the current year. The factory production of fats and oils was as follows: Fish oils, 19,737,357 pounds; animal fats, 436,674,135 pounds; grease, 100,799,825 pounds; and vegetable oils, 276,647,937 pounds. And this brings us to the adaptability of the electrical process to the extraction of oils from vegetable sources.

Up to the moment, the method has been applied only to copra, the well-known form of dried cocoanut from which we get a great deal of the basic material for nut butter and other edible commodities, not to mention oil for various purposes. Copra has a cellulose fiber which necessitates the grinding or thorough macerating of the cocoanut in order to stimulate the fullest electrolytic action. When this is done, the extraction of the oil is practically on a par with that effected when dealing with animal matter, and the product is of a high grade. There is every reason to believe that this novel system will prove a boon in the extraction of oil from linseed, soya beans, castor beans, cottonseed, peanuts, corn, and many other fatty or oil-bearing vegetables.

## San Francisco's Traffic Convention and Street Safety Show

By C. W. Geiger

(*Continued from page 431*)

word signs which govern traffic, just as the traffic officers do today. These signals may be manipulated locally or connected with a central timing device which operates for any desired length of time at any desired interval. This device was perfected by a Los Angeles inventor, and is now being installed at several street intersections in that city.

The semaphore is placed on an ornamental post at the property line of the intersection of streets, so as to be visible to all traffic. Four devices at each intersection, with the semaphore, a light and a bell giving three signals at the same time, permit traffic to proceed or stop. These signals are connected with a central timing device operated automatically for any length of time desired, so that an entire street may be thrown open for traffic north and south, and closed east and west. Then, on the other hand, all east and west streets may be thrown open for traffic and the others closed, or if it were desirable to open a street north and south at one intersection and close it at the next intersection sychronously, it may be done. There is in fact no movement of traffic which can be suggested that cannot be accomplished with this regulator. The signals are plainly visible and audible day or night, and always in operation. Traffic is always regularly moving, and for any time desired in any direction with absolute safety.

There is provided either central or local control at each intersection, at all times, so that an officer may instantly assume control, at any intersection, at will. It has been suggested that this device may prove practical to supplement the regulation at every congested intersection, with a traffic officer during certain hours; however, this is not necessary, as the device completely regulates the traffic. The traffic officer, however, will be used at intervals, as there will be infractions of the traffic regulations, and this device will aid the officer in enforcing regulation, as he will not be required to be stationary.

The regulator can be used by the fire department and the police department in many ways. In order to permit fire department equipment to pass, traffic on any or all streets can instantly be brought to a standstill, if desired. This is possible because the system is so arranged that all four arms bearing the word "stop" can be raised, and all four arms bearing the word "go" lowered, thus stopping traffic.

## Use of Pulverized Lignite for Fuel in Australia

A NEW Australian syndicate has been registered at Melbourne "to mine, process, and deliver to prospective customers throughout the Commonwealth" pulverized lignite, or brown coal, which, it is claimed, can be used for steam generation or metallurgical purposes with most satisfactory results. The syndicate controls various brown-coal deposits throughout the State of Victoria, said to contain over 250,000,000 tons, and mining operations are well under way.

Many novel features have been introduced in mining and air-drying the lignite, as well as in the process of pulverizing and burning. The plans for the entire work were prepared by Roy N. Buell, of San Francisco, Cal., chief consulting engineer, and the plant which the company recently built at Abbotsford (a suburb of Melbourne) was erected under his personal supervision. His views on the subject of the treatment of brown coal in Australia are embodied in this report.

The most striking improvement in this new method of treating lignite, which is known as the "Buell system," is the means of air-drying at the mines, whereby the moisture content is reduced from 50 to 25 per cent in seven days. Briefly described, the process is as follows:

The lignite is mined in either shafts or open cuts, the coal crushed on the spot to egg size, then hoisted to the air-drying tipples at the surface by bucket conveyors. After drying about seven days, the coal is relieved of practically half of its moisture content and is ready for final treatment. This final process, which should be undertaken near the place where the fuel is to be used, consists of again crushing the coal—to about ½-inch mesh—after which it is passed through a rotary drier, where the moisture content is reduced to about 10 per cent. The fuel is then pulverized, separated by air, and stored in bunkers.

To use it is blown through pipes, where it is mixed with air in quantity 10 per cent in excess of requirements and ignited at the tip of an adjustable burner, which enables the length and width of the flame zone to be most accurately gaged. Boiler tubes and baffles are kept clear of ash by soot blowers and suction conveyors carry off the ash to any desired place of disposal. Three per cent of the power generated is required to operate the plant, and one experienced man can fire a whole battery of boilers or kilns.


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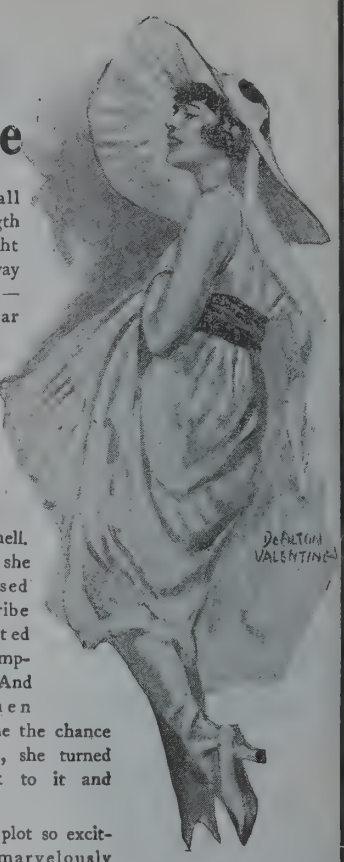


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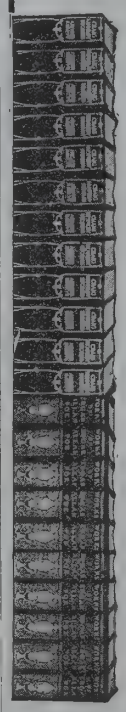

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DARING EXPLOIT OF OUR NAVAL CONTESTANTS IN THE RECENT BALLOON RACE.—[See page 447]

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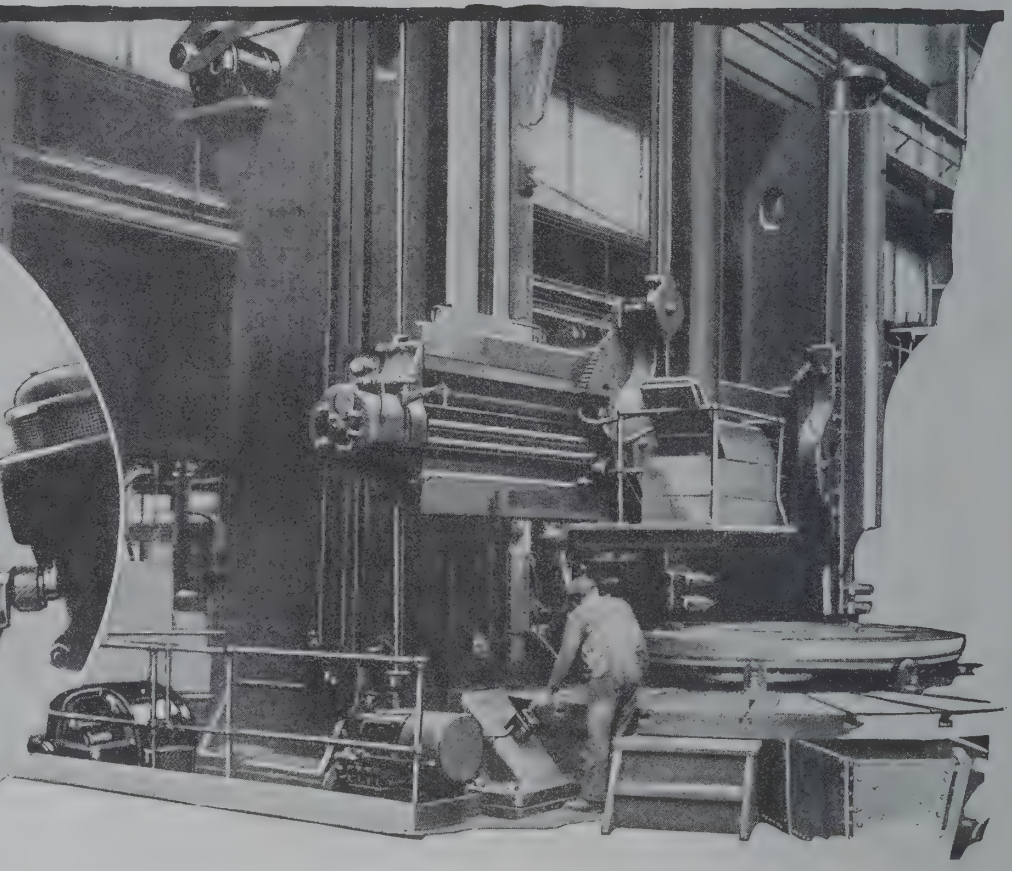

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## The True Role of Water Power

By C. D. Wagoner

AFTER 10 years of contention and a serious drain on the coal and oil fields throughout the country, the door has been thrown open for "white coal" to serve industry and the home by the signing of the water power development bill. The vast water powers of the country may now be utilized.

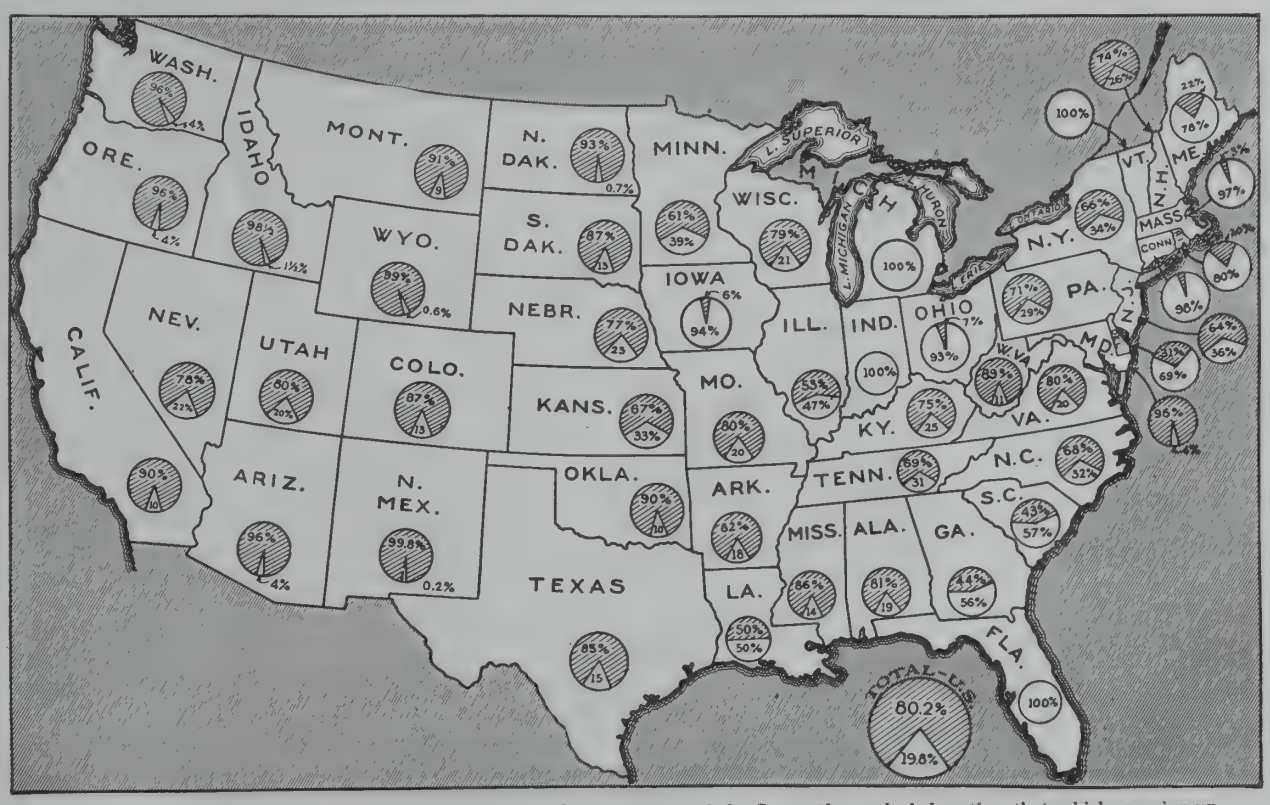
Fifty million horse-power comprises the total, both steam- and water-generated, now in use in the United States. It is conservatively estimated that as much more can be developed by utilization of the water power resources. The Department of the Interior has placed the potential water power at 60,000,000 horse-power of which but 10,000,000 is now developed. This saves the country upward of 33,000,000 tons of coal annually.

Assuming that a steam-produced horse-power generated daily for 12 hours throughout a period of twelve months requires the consumption of five and one-half tons of coal, the substitution of 50,000,000 horse-power from water should make an annual saving of 275,000,000 tons of fuel and avoid the movement of 7,000,000 freight cars. The economic gains, if we made use of our falling waters, would be tremendous, yet there is in service today but 10,000,000 horse-power developed by hydro-electric plants.

It is not contended that water power can entirely take the place of coal. In some instances a substitution for "black coal" cannot be made, but as a supplement it will add greatly to the total, pull down the average cost per unit, set electricity to work in the home far more extensively than at present and bring about such public comforts as the substitution of electricity for coal has done on some of the larger railroads.

But the power of our water can never completely replace the use of coal and oil for power purposes. While the new Federal legislation is a big forward step in fuel conservation, the maximum possible hydraulic energy of the nation is little more than the total energy which we now produce from coal and is about equal to the present total energy consumption of the country including all forms of energy. This means that the idea that when coal once begins to fail we may use the water power of the country as the source of energy, is, and must remain a dream. If all our potential water powers were developed and every rain drop used, it would not supply our present energy demand. Thus hydraulic energy may and should supplement that of coal, but can never entirely replace it as a source of energy. This probably is the strongest argument for efforts to increase the efficiency of our methods of burning coal, and to place at the disposal of the internal combustion engineer both new sources of petroleum fuels and new fuels of non-petroleum nature.

In this country the production of oil has already passed its peak, and in the world as a whole it will in a comparatively few years become of diminishing importance as a power producer, according to experts. There are still large reserves of coal in this country, though the greater ones are in the distant West, and the coal-producing countries are still far from exhaustion, but with the double price of coal, due in part at least to the increased cost of getting it out of the ground, coal-made power will be on the steady rise, it is predicted. In the creation of power, coal and oil are consumed and cannot be replaced. Therefore, it is asserted, the country which in future competition depends wholly or in great part on coal and oil power will be in a position of increasing disadvantage. On all these grounds the full development of our water power is something to which we must give attention.




The shaded section in each circle indicates the developed water-power of the State; the unshaded section that which remains undeveloped. No attempt is made to compare or even to state total developed or potential horse-power for the several States as against each other, but merely to show how far each State has gone in the utilization of such resources as it has.

**The extent to which the States of the Union have harnessed the power of their white coal**

## Repairing the Propeller of a Destroyer

THE *Panama Canal Record* describes an interesting repair made on the starboard propeller of the destroyer "Thornton," in the 1,000-foot dry dock at Balboa in May. The propeller had been damaged by touching one of the banks while in transit through the Canal. The ends of the blades had been turned back through half of a circle. The blades were straightened and brought back to their original surface. Cracks were welded, the broken tips of two blades were repaired by burning (casting new metal into a mold at the end of the tips so that it fused with the old metal), and the propeller was balanced and replaced.

Inasmuch as this is a high-speed turbine propeller, transmitting heavy horse-power and attached to a light hull, lack of balance or truth of surface in the repaired propeller would have set up a serious vibration. After the destroyer had gone to sea the commander telegraphed that the propeller was performing very satisfactorily, and congratulated the Panama Canal on "a difficult repair well carried out."

## The Rate of Speed at Which Bacteria Travel

WHEN one observes by means of the ultra-microscope the germs moving in a suspended drop of liquid one is frequently struck not merely by the fact that the form of the trajectory differs according to the species, but also by the difference in the rapidity of travel, which is often very considerable. Some of them move almost indolently, while some travel with great agility in one direction or another, and still others cross the field of observation at such a rate of speed that they give the impression of the flight of an arrow.

The average speed of each species of bacteria can be approximately calculated if one takes care to follow the course, in a suspended drop containing only a few germs, of the individuals which cross the field as nearly as possible along the line of the diameter, from one point to the opposite point on the circumference.

Mr. G. Sanarelli, the Director of the Institute of Hygiene of the University of Rome, continuing the researches previously made by Gabritschewsky, Stigell and Lehmann, and Fried, has determined the speed at which the cholera vibrion travels when the surrounding temperature is 25 degrees Centigrade, with cultures of various stocks 24 hours old developed upon agar-agar and afterwards painstakingly diluted in the serum of the guinea pig.

He found that the apparent average speed of motion is 10 centimeters per second; the actual speed corresponding to this is 0.125 millimeters per second, *i. e.* 7.5 millimeters per minute or 45 centimeters per hour. However, these figures are incapable of giving an idea of the dizzying rapidity of the vibrion as seen in the microscope. This is because the impression of speed obtained does not depend upon the *effective* speed but upon the *angular* speed. Regarded from this point of view the motion of the cholera germ give the same impression as a train passing in front of an observer at a distance of 40 meters at the rate of 16 meters per second or 57.6 kilometers per hour. The cholera germ travels at a much faster rate than any other microbe examined by Mr. Sanarelli, moving three times as fast as the *B. prodigious* and the *B. pyocyanus*, five times as fast as the *B. typhus*, ten times as fast as the coli bacillus and the *Proteus vulgaris*, and twelve times as fast as the *B. megatherium*.

Since all of these bacteria are provided with a number of cilia, while the cholera vibrion has as a rule only a single one, the rapidity at which microbes move appears to bear no connection with the number of their organs of locomotion.

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## New York and the Proposed St. Lawrence Waterway

WE have already gone on record as being opposed, so far as New York State and City are concerned, to any diversion of effort from the recently completed barge canal to the proposed waterway through the St. Lawrence River. This does not mean that we are opposed to the St. Lawrence project as such. On the contrary, we believe that as an engineering project it is feasible and that commercially it will ultimately prove to be of great benefit not only to the Western States but to the State of New York and to the industrial centers which lie between the Erie Canal and the Canadian border.

The Erie Canal is an accomplished fact. Excellently built and showing everywhere today its full depth of twelve feet of water, it remains now to furnish the canal with two essentials to its success: first, adequate and thoroughly up-to-date terminals with public grain elevators at Buffalo and New York; and secondly, the removal of Federal operation, limited though it is, and the sale of the present Federal-owned barges to private operators—this last a movement which would encourage private capital to construct a fleet of barges adequate to handle the growing traffic of the canal. We are among those who believe that if these things be done, the new waterway between the Great Lakes and New York Harbor will fulfil all the promises upon which the State was led to commit itself to the labor and cost of construction.

The St. Lawrence project is of a totally different character from that of the State Barge Canal. An International Joint Commission is conducting a series of hearings, both in Canada and the United States, designed to gain information and gage public sentiment upon a scheme for deepening the St. Lawrence River so that it can be used by vessels drawing at least 25 feet of water. The work would be done jointly by the United States and Canadian Governments. The latter has already spent much money upon the St. Lawrence route and is committed to further expenditures. At present it is reconstructing the Welland Canal, which is to have a depth of 25 feet, the total cost of this work being about one hundred million dollars. The work is about one-third completed; but it is realized that the full benefit of this outlay cannot be secured unless the St. Lawrence is rendered navigable to a similar depth. The distance from Lake Ontario to tidewater at Montreal is 181 miles, and the work to be done in deepening the river will be confined to 46 miles of this distance.

The great delay in moving last year's crops, which was due to the congested state of the railroads, has naturally stimulated interest in the proposed St. Lawrence waterway; and it is believed that if deep-sea ships of from 5,000 to 9,000 tons could pass freely between the shipping ports of the Great Lakes and the various ports of the world, not only would the wheat-growing interests of our Western States be benefited, but there would be a very considerable development of other traffic.

On the other hand, it must not be forgotten that the St. Lawrence route will always labor under certain serious disadvantages which can never be removed. For several months of the year the river is closed by ice; and furthermore, even when the river is clear, it is subject to fogs which, as many disasters have shown, render navigation hazardous and naturally tend to increase insurance charges.

To many of us the incidental advantages of opening this waterway seem to be of even greater promise than its direct advantages as a deep-sea route from the Lakes to the Atlantic. The incidental advantages are that the fall of the river and its great volume open up large possibilities of hydraulic-electric development. Thus, in the so-called international section, the river falls 91 feet in 68 miles, and in the Canadian section it falls 130 feet in 70 miles. Preliminary study of the question would indicate that in view of the uniform and heavy flow of water throughout the year, the improvements of the river for navigation will make available a sufficient volume and head of water to produce approximately four million horse-power in the stretch between Lake Ontario and Montreal. The estimated cost of the necessary improvements runs up to three hundred million dollars; but it is believed that the full development of the hydraulic energy would provide sufficient income to pay interest upon the whole cost of the work. So rapid has been the improvement of long-distance transmission that the power thus developed could be made to serve the upper half of New York State, including the cities that border upon the Erie Canal, and it would also be available in New York City and throughout the greater part of New England.

The resulting reduction in coal consumption and the lower cost of power to the industries should appeal strongly to such a manufacturing center as New York State. The Western States naturally are more interested in the improved navigation. In any case, this project is too large and contains too much promise for the future to be ignored or actively combatted by the people of this State. When the Government engineers shall have finished their surveys and a detailed and reliable report on this great project has been presented and passed upon by the International Joint Commission, the city and State of New York will be in a position to judge dispassionately of the merits of the problem. Meanwhile, it will be a good business policy to bend every effort to the development of our own recently completed waterway.

## Admiral Benson on Our Merchant Marine

AS a declaration of the aims and policy of our Shipping Board and a statement of the scope of its operations, the recent address of its chairman, Admiral Benson, will be welcomed by those who are following with close attention the operations of that great governmental institution. It is to be regretted that public interest in this matter is not more widely spread. For not alone are the maritime States and, more particularly, the leading ports of this country concerned in our merchant marine, but the great interior States, if they could only be brought to realize it, have an interest that is equally vital.

We are glad to note that Admiral Benson at the outset deprecates the notion that our great shipbuilding effort is promoted merely by a spirit of rivalry. He points out that the operations of the Shipping Board have grown to their present magnitude as the result of war conditions. Previous to the war we were content to see our commerce carried in the bottoms of other nations, and it was not until we were urged by our allies to engage in shipbuilding on a stupendous scale that we attempted to rehabilitate our fast diminishing fleet. At a time when the civilization of the world was at stake we were told that the crying need was for ships and yet more ships. How promptly we responded is a matter of record, and the coming of the armistice found us at the high peak of our effort.

The Shipping Board came into existence several months before we entered the war, and its real purpose was to serve as a regulatory body of shipping, with vast powers that could be utilized to build up our merchant fleet. The magnitude of our accomplishment is seen in the fact that between the declaration of war and the time when our men were ready for hostilities, 95 per cent of their supplies and about 45 per cent of the men themselves were carried over in American bottoms.

We have a total deep sea fleet of over ten million tons; more than half of this is represented by the Shipping Board fleet; and naturally the latter includes the newest and most efficient of our vessels. Having this fleet, and our production of merchantable goods, raw and finished, being greater than ever before in our history, it is the purpose of the Shipping Board to bend every energy to the carrying of these supplies, or at least of the greater part of them, in American bottoms. Admiral Benson states that it is essential that the world should understand that while we fully appreciate the service hitherto rendered by other nations, we are now ship-independent in the development of our ocean-carrying trade.

We are glad to note that the chairman goes on record once more as being thoroughly in favor of private ownership. He tells us that he would use his influence to bring it about "that not only my own but other governments be brought to a point where they fully agree to retire absolutely from ocean carriage," since this would mean only uneven competition with the private owner. "We are endeavoring to do this," says the chairman, "as quickly as possible—and the law demands it."

## Radio Control of Naval Units

DOWN through the long history of naval warfare and particularly during the last fifty years of it, successive inventions have been hailed upon their appearance as being "revolutionary." Armor plate, the rapid-firing rifled gun, the torpedo, the torpedo boat, the submarine and now the airplane, have been quoted as destined to turn everything naval upside-down, and lead overnight to the scrapping of the existing instruments of battle and the substitution in their place of the new wonder. In varying degrees, but in infinitely less measure than was predicted, the successive inventions have modified the art, or rather the instruments, of naval warfare; but not once have they revolutionized it. The student of naval history will find that these predictions have come mainly and almost exclusively from the pen of the layman. Rarely is it that the professional mind leaps to extravagant and over-hasty conclusions of this kind. Occasionally it does, and for proof of it we have only to bear in mind the recent pronouncements of Admirals Sir Percy Scott and Lord Fisher.

Just now we are beginning to hear about the great possibilities of distant radio control of naval weapons which hitherto have required direct manual control. Experimental work carried on during the war proved that such control is possible, under favorable conditions, to an extent which before the war would have been scouted as quite impossible. Thus, it was shown that an airplane could be loaded with high explosives, sent up into the air without any pilot aboard, and directed by means of a new radio-control system installed on a pilot machine. It was proved that this controlled machine with its high explosive charge could be flown in the desired direction and made to strike unerringly any desired objective.

In other experimental work, carried out, like that to which we have just referred, under government auspices, it was proved that a torpedo may be steered into contact with its objective by means of radial impulses sent from an observing pilot plane flying overhead. Doubtless in the recent bombing of the old battleship "Indiana," use was made, if not of the same electrical appliances, at least of the same general principle. In this case, the "Indiana," without a single man aboard, steaming at ten knots was steered through radio control from the U. S. S. "Ohio," which maintained a distance of about five miles from the moving target.

It is too early to predict to what extent radio control can be substituted for manual control in aiming and firing the tremendous weapons which modern invention has placed at our disposal. If, for instance, the course of a torpedo can be controlled from an airplane and further experimental work fulfils the promise that is contained in this new method, we shall come nearer to revolutionary changes than ever before. This efficiency under war conditions, however, has yet to be proved.

## Electricity

**Electrically Deposited Thermocouples.**—A method of constructing thermocouples in which one of the elements is deposited electrically on a core, which constitutes the other element of the couple, is described in a recent issue of the London *Engineer*. In particular the couples investigated are those in which constantan is used with either silver or copper.

**An Arc Splitter** to lengthen the life of contactor tips has just been developed by a leading electric company. It consists of a refractory element which is so placed in the arc box of the magnetic blow-out as to project into the path of the arc, thereby forcing the arc to pass around it and thus increasing its resistance, causing it to rupture more rapidly. The arc splitter is immediately above the contactor tips.

**Alternating or Direct Current Bell.**—There has been developed an electric bell which operates equally well on alternating and direct current circuits of the proper voltage. The bell is designed so that the speed of the hammer is independent of the frequency of the current. A new principle in bell construction is used, consisting of a buckled steel spring coupled to the armature so that each stroke is very positive in action. The coil is wound on a laminated core and the hammer is under the gong.

**Carbon and Commutator Wear.**—It is said that although sparking voltages are the same in direct-current and alternating-current machines, the same sparking voltage may give widely different results under different conditions in either type of machine. Experiments are cited to show that the current density has an appreciable influence upon the arcing at the brushes. The influence of temperature and speed upon brush and commutator wear is also taken up in a recent issue of the *Journal* of the American Institute of Electrical Engineers.

**Defects in Lead Cables.**—While it is possible to detect the approximate location of a defect in a lead-covered cable, it is impossible to remedy the defect and recover the cable at that point without recovering the entire cable. It is sometimes necessary to strip the lead covering from a cable in order to reach a defect that has been discovered during a test, and make the necessary repair. Then the bare cable is again passed through the lead coating machine in order to replace its covering. This work necessarily involves a great expense, but it seems to be part of the business of making huge cables.

**A Double-Filament Lamp.**—Twice the life of the usual gas-filled lamp is the aim of a manufacturer who has recently introduced a double-filament lamp. This new lamp is placed in the ordinary socket in the same manner as the common type of lamp, and looks and operates in the same manner as the ordinary lamp up to the point where it burns out. Then the bulb is unscrewed from the socket, but, instead of throwing it away, a little cap is removed from the end of the base and the lamp is again put back into the socket. The removal of the little cap from the base brings the terminal of the second filament into place and allows the same lamp to be put back in service. Both the filaments are of equal wearing qualities.

**Has the Incandescent Lamp Limit Been Reached?**—Judging by the desire on the part of several incandescent lamp manufacturers to edge away from the one-half watt per candle-power rating of gas-filled tungsten lamps, it appears that we have been pushing tungsten filaments pretty hard. That is to say, we have about reached the absolute limit of tungsten filaments at one-half watt per candle-power rating, and if anything, we are too near the fusing point to make for good practice. It appears that greater efficiency with incandescent lamps can only be obtained if we discover some new filament material or a gas which is more suitable than nitrogen. Either of these possibilities seems remote.

**Color Screens for Window Lighting.**—A development that promises to be an outstanding feature in the practice of show-window lighting, and one that will have an influence upon every other branch of illuminating engineering, has recently made its appearance. Heretofore various devices have been resorted to for producing colored lighting effects, such as dipping the electric lamps in suitable dies, using sheets of colored glass, making the lamp bulbs of colored glass, and so on. But in every instance the heat of the lamp has ruined the colors. The latest device, which is reported to be a complete success, consists of a metal frame supporting a slide of colored gelatine which is held in place by a fine steel mesh. The slide slips in the frame and the latter, in turn, fits over the lamp reflector. In this manner the colors may be readily changed by inserting the desired slide. The colored gelatine holds its color remarkably well and is non-inflammable.

## Science

**Tree Rings and Climatic Fluctuations.**—For nearly twenty years Prof. E. A. Douglass has been studying the annual rings of trees, as found in various parts of the world, in quest of information concerning the history of climates. A complete account of his studies and their results is set forth in Publication 289 of the Carnegie Institution of Washington, "Climatic Cycles and Tree-Growth." Professor Douglass began with investigations on yellow pine in Arizona. By comparison with meteorological records he established the fact that the thickness of the annual rings seen in cross sections of the trees varied with the yearly rainfall. Having determined this relation for the comparatively brief period for which weather records were available he argued that the relation held good for earlier periods, and that sections of old trees would therefore furnish a record of fluctuations of rainfall for hundreds of years. His plan has been to study a group of trees of various species, appropriately located, for each region embraced in his investigations, and he has worked out some ingenious methods and mechanical devices for making his analyses and determining periodicities, etc. Sections were obtained from many parts of the United States and Europe, and, in the case of the *Sequoias* of California, the record has been extended back more than 3,000 years. Among the interesting discoveries announced by Professor Douglass is the fact that practically all the groups of trees investigated show the sunspot cycle or its multiples. There is also found a complex combination of other cycles, including a prominent cycle of about 2 years.

**Duration of Thunder.**—It is impossible to assign any theoretical limit to the duration of continuous thunder since the sounds of many successive lightning discharges may rumble so long as to merge into one another. In some cases the noise of wind and rain, accompanying the thunderstorm, may be so mingled with the thunder as to help produce the effect of a continuous rumble. The chief factor in the prolongation of a peal of thunder is the difference of time required for the sound to travel to the observer from different points along the path of discharge, which may be a mile, or perhaps several miles, in length. Under some conditions reflection of the sound from clouds, hills, etc., further prolongs the peal. But the Indian thunderstorms are notoriously violent, though comparatively harmless. According to Mountstuart Elphinstone, the setting-in of the monsoon in India is accompanied by such an electric convulsion "as can scarcely be imagined by those who have only seen that phenomenon in a temperate climate. It generally begins with violent blasts of wind, which are succeeded by floods of rain. For some hours lightning is seen almost without intermission; sometimes it only illuminates the sky and shows the clouds near the horizon; at others it discovers the distant hills, and again leaves all in darkness, when in an instant it reappears in vivid and successive flashes, and exhibits the nearest objects in all the brightness of day. During all this time the distant thunder never ceases to roll, and is only silenced by some nearer peal, which bursts on the ear with such a sudden and tremendous crash as can scarcely fail to strike the most insensible heart with awe."

**The Water-Supply of Armies.**—In a recent lecture by Lieut.-Gen. Sir Thomas Goodwin, K.C.B., of the British Army medical service, on the remarkable progress made in many lines of military hygiene during the war, much novel information was presented concerning methods of purifying the water-supply. Before the war dependence had been placed largely on the use of filter-candles, but they proved unsuitable for active service conditions and were replaced by chlorination. Chloride of lime in the form of bleaching powder was used throughout the war as the means of dealing with all water-supply, either in bulk, as in the big "water-points," or on a smaller scale. Special water-tank companies were eventually organized. These units were able to collect, filter under pressure through sand, sterilize by chlorine gas by means of an ingenious regulator, and transport large quantities of water wherever the motor-lorry could move. Along waterways barges were used for the same purpose. Any flavor of chlorine was removed by a "dechlorinating" process with sulfur dioxide gas. The new water units were also effective in testing water for mineral poisons. The success of water chlorination in the field led to its application to the municipal water-supplies at Boulogne and Rouen. The Americans adopted a similar scheme in some of the larger French towns occupied by their troops. General Goodwin points out that a result of the war has been the recognition of the sanitary service of the army as an organized department, and has aroused general interest in preventive medicine on the part of civilians.

## Naval and Merchant Marine

**Fate of the "Leviathan".**—Admiral Benson, being questioned as to the use to which the "Leviathan" is to be put, admitted that the situaion was a very trying one. He stated that it was difficult for any one firm, in the present state of the money market, to raise the necessary funds to buy the ship and recondition her. The United States Mail Steamship Company made an offer of three million dollars, provided the Shipping Board would make a loan of six million dollars to the company for reconditioning. Another condition of the offer was of 25 per cent of the net earnings of the vessel to the Board for ten years. Admiral Benson stated that personally he felt inclined to accept this offer.

**American Shipping in Our Carrying Trade.**—A recent United States Shipping Board survey of vessels entering and clearing in the foreign trade with cargo for the first six months of 1920 shows that a total of 15,558 vessels of 86,931,700 deadweight tons have entered and cleared U. S. ports in the six months ending June 30th, carrying 37,398,184 long tons of cargo. Vessels under American registry to the number of 9,550 (61.4 per cent of the total vessels) aggregating 51,534,620 deadweight tons (59.3 per cent of the total tonnage) carried 22,724,217 long tons of cargo (60.8 per cent of the total cargo carried). The American vessels carried 44.1 per cent of capacity load and the foreign vessels 41.5 per cent; the average for all flags being 43 per cent of capacity.

**Economy of Electric Drive.**—In a paper before the Institute of Marine Engineers, Captain W. P. Durtnall gives some authentic figures showing the relative economy of the reciprocating engine, of the electric drive and of the geared drive. These figures were estimated by the operating engineers of the "Florida" and "Utah," fitted with Parsons turbines, the "Delaware," with reciprocating engines and the "New Mexico," with the electric drive. The relative steam consumption per effective horse-power hour at twelve knots was for the "Florida," 31.8; the "Utah," 28.7; the "Delaware," 21.0; the "New Mexico," 17.3. At twenty-one knots the relative figures given are: "Florida," 13.0; the "Utah," 21.0; the "Delaware," 21.0; and the "New Mexico," 16.4.

**Activities of the Shipping Board.**—Shipping Board vessels carried during the last fiscal year a total trade of 20,615,402 tons, which passed in and out through 49 United States ports. That there is a marked concentration of this carrying trade is shown by the fact that 26 of the 49 ports handled over 90 per cent of the entire tonnage moved. New York stands first with 27.9 per cent, and Baltimore and Philadelphia next, each with 10 per cent. Next in order comes a southern port, New Orleans, which carried 7.6 per cent, then Norfolk with 7.1 per cent, and San Francisco with 5.1 per cent. A study of these figures shows a remarkable concentration of maritime traffic on the eastern seaboard of the country. The chairman has stated that it would be his policy to bring about a more widely extended distribution.

**Ships That Carry the 16-Inch Gun.**—We have ten battleships under construction which will carry the 16-inch gun. Of these, four, the "Colorado," the "Maryland," the "Washington" and the "West Virginia" will mount eight 16-in guns, and the "Indiana," the "Iowa," the "Massachusetts," the "Montana," the "North Carolina" and the "South Dakota" will each mount twelve 16-inch guns. In this connection we wish to correct a statement in an article, "Our Naval Standing," which appeared in the SCIENTIFIC AMERICAN of June 26th, where the "California" and the "Tennessee" are each credited with mounting eight 16-inch guns. As a matter of fact, these ships each mount twelve 14-inch guns. There was some discussion of the advisability of giving them eight 16-inch guns when the 16-inch gun, after proof, showed its excellent qualities, but nothing came of it.

**The Fate of the Surrendered German Ships.**—The ships that formed the remainder of our share of the surrendered German fleet, consisting of the battleship "Ostfriesland," the scout cruiser "Frankfort," three three destroyers and a few submarines will not be incorporated in the active navy of the United States. The "Ostfriesland," the most important of the surrendered ships, was ninth in line at the battle of Jutland. She received no great hurt in that battle but was seriously injured by contact with a mine during the flight of the German fleet in the early morning following the battle. The "Frankfort," a fast cruiser, was actively engaged in the war, especially at Jutland. There are also three destroyers, the G-102, which is somewhat larger than any destroyer of our Navy, the S-132, of about 600 tons, and the B-33. Ultimately, the "Ostfriesland" will be used as a target.

# The Problems of Electrification

## The Struggle Toward a Standard, and What Is Likely to Come of It

By Robert G. Skerrett

**The electric locomotive demonstrating its greater economy and efficiency in terminal yards**

ACCORDING to the latest official figures, we have upon our 230,000 miles of steam lines a matter of substantially 2,500,000 freight cars and quite 30,000 freight locomotives, not to mention 15,000 engines at terminals for switching service. Offhand, this array of rolling stock might seem ample for our needs, but an analysis of what it has been doing recently will make it clear that there is something radically faulty in performance, especially in view of the many million tons of goods of all sorts that are cluttering stations and warehouses awaiting much-delayed distribution. To be specific: the final report of the United States Railroad Administration reveals that the average miles per freight car per day were about 22; that each loaded car carried as a rule something less than 30 tons; and that fully one-third of the car miles was run without lading. Finally, we find that each freight engine made an average of approximately but 60 miles every twenty-four hours.

One does not have to be versed in higher mathematics to realize that there is a tremendous lack of service or wastage under existing conditions. Why is this the case? What is the logical relief? It is not necessary to reiterate in detail the multiple operative shortcomings of the steam locomotive, but let us sum up a few of them. It seems that one-quarter of the coal mined annually in this country and six per cent of our fuel oil is consumed by the steam engines of our railways, and a good third of those combustibles is sacrificed in what are termed "stand-by losses." Aside from that, the fuel is inefficiently utilized when the locomotives are actually doing work. Further, the distribution of coal for our trunk lines requires a tonnage movement amounting to approximately 20 per cent of the total freight-ton miles that should yield revenue. This is not hard to understand if we recall the fact that there is first the transportation of the fuel from the mine to the coaling station, then its wanderings on the engine tender, and next the trip of the empty coal car back to the colliery. It is authoritatively declared that the tenders of our steam locomotives of all kinds add about 11 per cent to the ton mileage of our roads without bringing in a return.

Plainly, to just the extent in which we may find a way to reduce the ton mileage of railway coal or oil we shall be able to utilize the cars so freed for the carriage of other essential freight. In 1918, our steam lines burned 163,000,000 tons of coal and 45,700,000 barrels of oil. According to Government data, counting an average load of 30 tons, 5,677,000 car trips were needed to deliver the fuel during that year. This arraignment of the steam locomotive would be incomplete if we failed to take into account the handicaps imposed by seasonal and atmospheric conditions as well as the steam tractor's inadequacy when it comes both to mounting and to descending steep grades with heavy trailing loads.

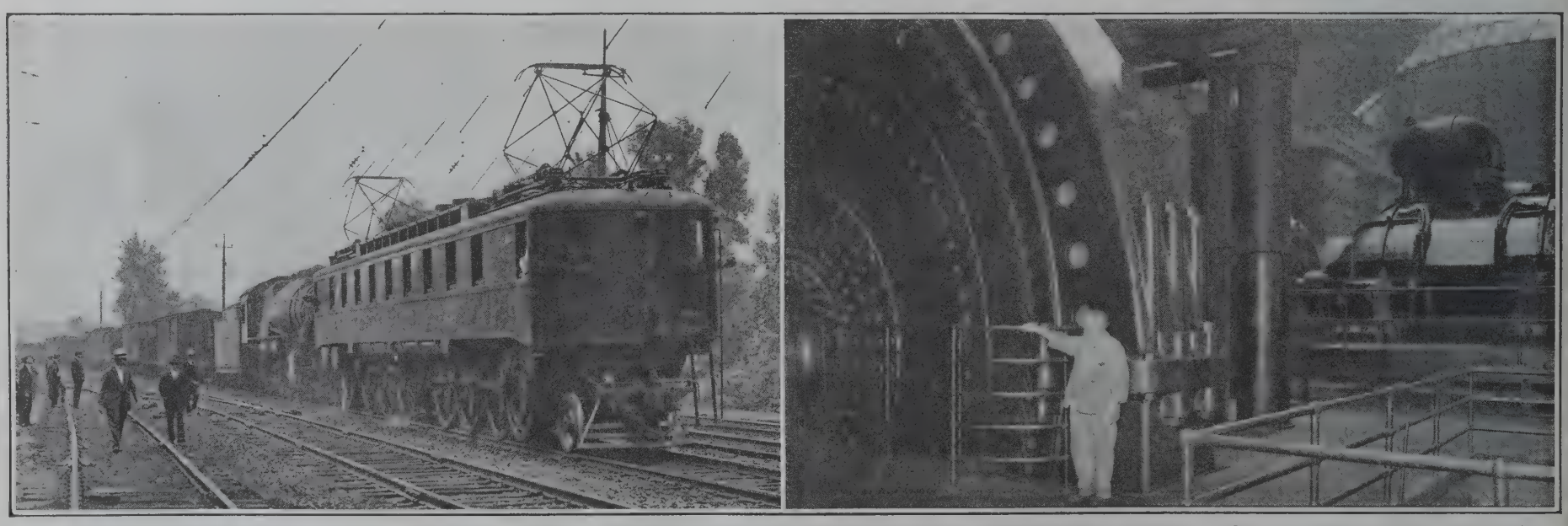
Anyone with a moderate knowledge of the physical geography of the United States must be alive to the fact that the mountainous nature of many sections interferes greatly with rapid movement on the part of both passenger and freight service, but much more so in the case of freight trains. Because of numerous heavy gradients, engineering difficulties, and the expense entailed, the mountain routes are frequently single-track lines and seldom more than double track. Thus, the tide of traffic is slowed down and passed through constricted channels. This would not be so bad if the steam engine could maintain a higher speed when climbing and descending these slopes, but unfortunately the steam locomotive cannot do this. It must materially reduce its load when going up hill in order to pull the train along and, because of its deficient grip upon the rails it often cannot hold safely back the same number of laden cars when sweeping down the opposite incline.

Therefore, we have a reversal of the very action upon which we normally count when we seek to shift from one reservoir to another a given fluid volume by means of a relatively small connecting conduit. That is to say, just where increased velocity is essential on our railways we cannot have it. Every now and then some of our steam roads—and these frequently among our most important trunk lines—have to contend with this bottle-necking, and it is at these points or along these sections that the freight movement is throttled.

The apparent solution of the problem, which is becoming more and more acute from year to year, is the substitution of electric traction. Out west one transcontinental road is pulling trains of 4,000 tons up and down steep mountain slopes and exercising perfect control the while. It is doing this at speeds hitherto unattained under like circumstances, and the schedule is being maintained with remarkable regularity. Not only that, but the oper-

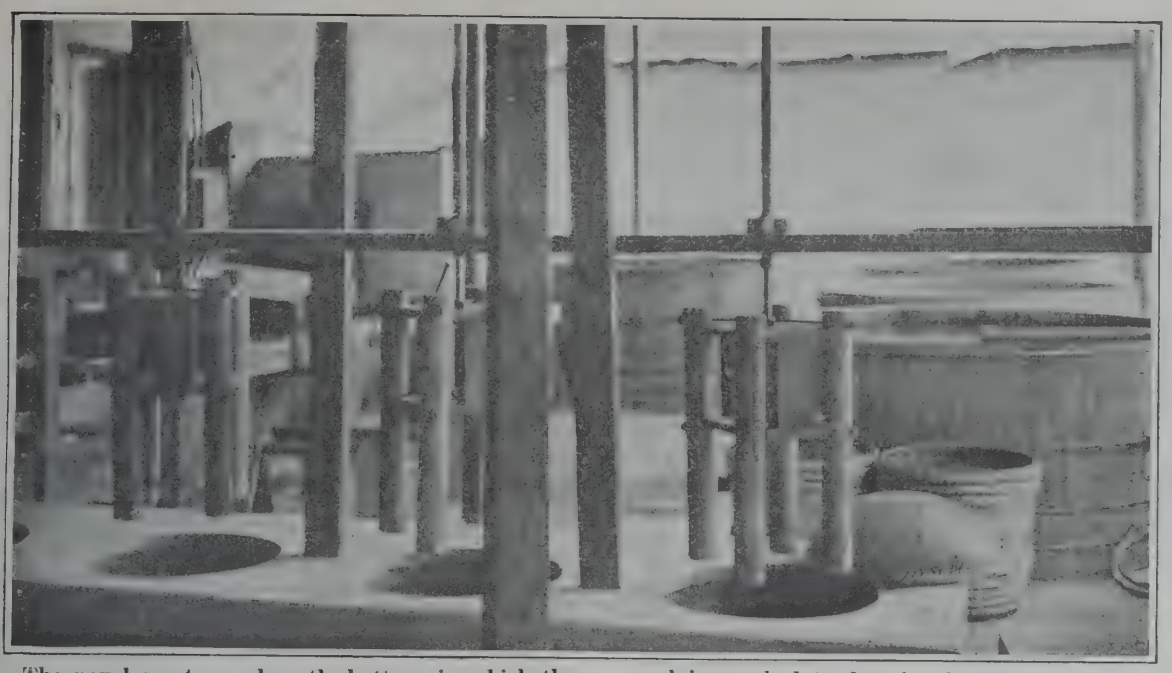
(*Continued on page 457*)

*TO tell the average American that we have outgrown steam traction will probably shock him as he casually judges the apparent efficiency of the speeding express, or comes upon an occasional freight train in the course of his daily habit of life. Yet the fact remains that such is the status of our land transportation system when the aggregate movement of cars and tonnage is considered. Our national well-being is contingent upon an improvement in this matter; and it appears that improvement is possible only through the substitution of electricity for steam as a motive power. Mr. Skerrett tells us in this article something of the manner in which this substitution must be effected.*—THE EDITOR.



*Left:* A powerful electric locomotive of special design that has saved the day in speeding up freight traffic on one trunk line. *Right:* In the foreground a big dynamo driven by reciprocating engine; in the middle distance a steam turbo-generator set of like power, much higher efficiency, and far less bulk. Where fuel must be employed for the generation of current, it is units of the latter type that will be relied on in large railroad central stations

**Typical units that are making electrification of our railroads a success**



The novel mortar-and-pestle battery in which the seaweed is crushed to free it of clinging shells, sand and alkali

Agar-agar—the finished article in silvery sheaves of an average weight of three pounds each

## California's Seaweed Industry

By John L. Von Blon

AGAR-AGAR, that valuable aid to medical science and important food adjunct for the supply of which the world heretofore has relied solely upon the Orient, is about to be extensively manufactured in the United States. An American company already is turning out a third of a ton daily in a finely-equipped plant at Glendale, a suburb of Los Angeles, California, and steadily will increase its capacity. Thirty-five thousand dollars' worth of specially-designed machinery has been installed in an artistic concrete building having 15,000 square feet of floor space and a five-acre surrounding lot which also is utilized. This marks the establishment of a new industry with great possibilities, or rather the transplanting of an old one to virgin soil. And it is an interesting progressive departure inasmuch as only crude mechanical appliances are used in the Far East.

Japan has enjoyed a monopoly in agar-agar, and last year this country imported 240 tons, of approximately half a million dollars' worth from there, and Great Britain and other European countries much more. Consumption is heavily increasing although the public generally never has heard the name. It is a gelatin-like derivative of seaweeds and meets wants which nothing else can. In Japan but ten species of the marine algae required are found. Two years' diligent research disclosed that fifteen species of superior quality grow in comparative abundance along the southern California coast. The Glendale factory is the result. There it is demonstrated that the American finished article far excels the hand-made oriental product. In their eagerness to increase their profits the Japanese mixed plants other than algae with seaweeds and thus imposed upon the entire world. One of the large eastern pharmaceutical manufacturing concerns is negotiating for the whole California output, and the War Department also is looking to that end. A certain prepared package of agar-agar weighing eight ounces sells for about a dollar.

"Kanten," as the Japanese call agar-agar, long has been esteemed there as a food, and as such it appeals more and more everywhere. It is a wholesome and delicious thickener in jellies of all sorts, fruit, meat or fish. It is particularly beneficial mixed with any ordinary cereal or breakfast foods with the addition of sugar or salt. In candy making, too, this strange gift of the ocean is a factor. It goes far and a pound is sufficient to supply an ordinary family for many months; but the price has jumped from 50 cents to $1.25 and over during the emergency of the past few years.

The major demand is from hospitals, laboratories and the medical profession. The peculiar substance has no equal as a culture media for bacteria, retaining its solidity, unlike gelatin, at the requisite temperatures, and thus proving indispensable to bacteriological research and segregation. During the war it figured successfully in the healing of certain wounds. It has the natural property of absorbing water and retaining it; and, in medicine, the additional property of resisting the action of intestinal bacteria and of the digestive enzymes. It is employed as a mechanical stimulant or alterative to overcome constipation without the violent action characteristic of effective cathartics. It has no inherent flavor, little nourishing power, and doesn't digest. It promises to displace many drugs which leave harmful after-effects.

Those seaweeds constituting the basis of agar-agar are prolific off Cayucos, San Luis Obispo, Santa Barbara, Los Angeles, Oceanside and down along Lower California. Among others are *Geldium corneum* and *cartilagineum*, *Gracellaria confervoides*, *Euchema spinosium*, and various forms of *Tenax* and *Gigarteneae*. The leaves, dainty and beautiful, brilliant red, purple, pink, yellow, white or black, are hunted on the beaches by tourists and pressed and treasured as "sea moss." The plants grow only on rocks and as a rule where they can be gathered at low tide, though in some localities expert divers get the best. Off California they attain a height of two feet and are slightly coarse. In Japan, stunted by 250 years of picking, half that size is the maximum. The average worker on fairly good "ground" can harvest 200 (dried) weed, or one bag per day, and for this he is paid $20 f.o.b. Glendale—10 cents a pound. To get 200 pounds of dry weed he must pick 600 pounds wet. It is pulled up with the hands. Most of the supply comes from fishermen under contract, and American labor is so high that they find it more profitable to carry the algæ up from Mexico, where four boat crews now are working.

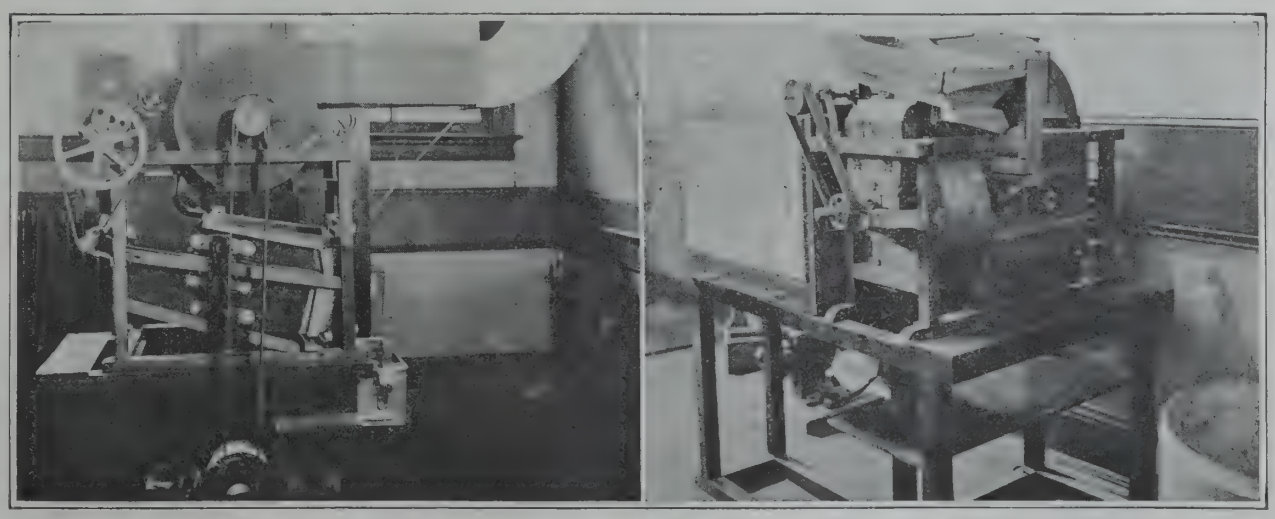
(*Continued on page 458*)

## Setting Federal Wheat Standards

By George H. Dacy

IN order to evolve grain-grading standards of general application and satisfaction, the scientists of the Federal farming forces at Washington are now utilizing a minature flour-milling plant and bakery in order to test out all of the varieties of wheat grown in this country and to ascertain definitely their intrinsic value as measured in terms of the size and quality of the loaves which they produce. The small scale testing plant is outfitted as far as possible as an exact replica of a large commercial mill. Its equipment includes two grain separators and a scouring machine which remove foreign matter from the wheat and prepare it for tempering and milling. The mill proper, which is of the non-automatic type, consists of four single stands of six-by-six-inch rolls, three of which are corrugated while the other is smooth. It is operated in such a manner that it practically duplicates the flow of a five-break, nine-reduction roller mill such as is largely used commercially.

After the samples of wheat have been graded according to the Federal standards now in effect, the grain is cleaned and then passes through the mill which converts the kernels into flour. The flour is stored for a few days and then is made into dough and baked into bread in the miniature bake-shop which is operated in conjunction with the flour mill. The bakery is equipped with a modern electric baking-oven, an up-to-date dough-mixing outfit and a sponging cabinet heated by electricity where the dough is placed for rising. After each sample of flour is converted into bread, the latter product is examined carefully as to color, texture, flavor of the bread and expansion of the loaf, these data being of value in checking up the baking qualities of the flour as compared with its milling merits. All this information is useful in checking up the grain-grading records of the various samples of wheat tested. Every variety of wheat in the country—of which there are over 150 different kinds—will be tested out by Uncle Sam's scientific experts and the results of these investigations will be of ultimate and future value to every bread consumer in the entire country.



The receiving separator that cleans out the weed-seed, chaff, straw and other foreign matter from the grain.

The scouring machine that eliminates the smut, beards, and other material that cling to the bran.

**Accessories of Uncle Sam's miniature mill and bakery that are employed in standardizing grain tests**

## Nickel Babbitt

FOUNDRY, in answer to a question states that many so-called nickel babbitts contain no nickel, but that a nickel babbitt can be made containing 4 per cent of copper, ½ per cent nickel, 10 per cent antimony, and 85½ per cent tin. The copper and nickel are charged together and covered with charcoal. Antimony is added gradually, and then the tin.

# Edison's Views on Life and Death

## An Interview with the Famous Inventor Regarding His Attempt to Communicate with the Next World

As Reported by Austin C. Lescarboura

*WHEN a man of the standing and personality of a Lodge or an Edison interests himself in a subject, the public is never cold to the announcement of what he is doing and what he hopes to accomplish. So when the news went out, the other day, that Edison was carrying on experiments looking toward communication with the dead, the newspapers gave the item a place out of all proportion to that which its intrinsic importance in the scientific progress of the day and the stage to which Edison's work has progressed would have entitled it. In this they were quite right, because their readers were interested in the bare news that Edison was working on the problem. We believe that our readers, too, are interested in what Edison is doing in this field and what he has to say about his theories and his work. Hence this interview, in which Mr. Edison, himself, tells us what he believes about survival and why he hopes to establish communication. And if one thing stands out clearly beyond all other things in this interview, it is that regardless of the manner in which sensational newspaper stories may present the matter, Edison stands for a return to sanity in our attitude toward the possibility of survival of personality and communication with those who may have survived.*—THE EDITOR.

EDISON—the man who has given us the electric light, the phonograph, the motion picture, the nickel-iron storage battery, the perfected dynamo and a vast collection of other devices entering into our everyday life—is about to devote himself to something which is infinitely more interesting than any invention can ever be. Here we are, something like one billion five hundred million human beings, facing death sooner or later yet totally ignorant of what is to become of our personalities. And the same can be said about our coming into this world, for life and death remain the greatest mysteries of the ages.

Several weeks ago the word was passed around to the effect that the great inventor was working on a device, or apparatus as he prefers to term it, to communicate with personalities which have passed on to another existence or sphere. Immediately the press of the United States and Europe announced that Thomas A. Edison had joined the ranks of the spiritists, which now number many a prominent scientist, author, inventor, physicist, engineer, clergyman, and so on. Soon the highly imaginative French writers drew pen pictures of Mr. Edison's apparatus serving as a telephone station or telegraph office or whatnot, where persons wishing to communicate with those who have passed on could do so in a positive and prompt manner.

And no one is more sorry than Mr. Edison that this impression has been permitted to gain ground both here and abroad. "In the first place, I cannot conceive such a thing as a spirit," said Mr. Edison to the writer. He meant it, too. "Imagine something which has no weight, no material form, no mass; in a word, imagine nothing! I cannot be a party to the belief that spirits exist and can be seen under certain circumstances and can be made to tilt tables and rap and do other things of a similar unimportant nature. The whole thing is so absurd."

In fact, it was mainly for the reason of correcting the impression about Mr. Edison's activities in this latest field of research that the inventor granted the writer an interview. The apparatus which he is reported to be building is still in the experimental stage. Obviously, Mr. Edison is too cautious and too well founded in the uncertainties of any new experimental work to say anything definite at the present time. However, he wishes to say the following, which is very significant in the light of his past record in so many fields of endeavor:

"I have been thinking for some time of a machine or apparatus which could be operated by personalities which have passed on to another existence or sphere. Now follow me carefully; I don't claim that our personalities pass on to another existence or sphere. I don't claim anything because I don't know anything about the subject. For that matter, no human being knows. But I do claim that it is possible to construct an apparatus which will be so delicate that if there are personalities in another existence or sphere who wish to get in touch with us in this existence or sphere, this apparatus will at least give them a better opportunity to express themselves than the tilting tables and raps and ouija boards and mediums and the other crude methods now purported to be the only means of communication.

"In truth, it is the crudeness of the present methods that makes me doubt the authenticity of purported communications with deceased persons. Why should personalities in another existence or sphere waste their time working a little triangular piece of wood over a board with certain lettering on it? Why should such personalities play pranks with a table? The whole business seems so childish to me that I frankly cannot give it my serious consideration. I believe that if we are to make any real progress in psychic investigation, we must do it with scientific apparatus and in a scientific manner, just as we do in medicine, electricity, chemistry, and other fields.

"Now what I purpose to do is to furnish psychic investigators with an apparatus which will give a scientific aspect to their work. This apparatus, let me explain, is in the nature of a valve, so to speak. That is to say, the slightest conceivable effort is made to exert many times its initial power for indicative purposes. It is similar to a modern power house, where man, with his relatively puny one-eighth horse-power, turns a valve which starts a 50,000-horse-power steam turbine. My apparatus is along those lines, in that the slightest effort which it intercepts will be magnified many times so as to give us whatever form of record we desire for the purpose of investigation. Beyond that I don't care to say anything further regarding its nature. I have been working out the details for some time; indeed, a collaborator in this work died only the other day. In that he knew exactly what I am after in this work, I believe he ought to be the first to use it if he is able to do so. Of course, don't forget that I am making no claims for the survival of personality; I am not promising communication with those who have passed out of this life. I merely state that I am giving the psychic investigators an apparatus which may help them in their work, just as optical experts have given the microscope to the medical world. And if this apparatus fails to reveal anything of exceptional interest, I am afraid that I shall have lost all faith in the survival of personality as we know it in this existence."

Mr. Edison does not believe in the present theories of life and death. Long ago he turned his back on the various old and accepted theories because he felt that they were fundamentally wrong. And just as he experimented with one substance after another without ever becoming discouraged in his search for the filament of the first successful incandescent electric lamp, so he has searched and reasoned and built up a structure which represents his theories of what is life.

"I believe that life, like matter, is indestructible," began Mr. Edison, in outlining his theory of life and death. "There has always been a certain amount of life on this world and there will always be the same amount. You cannot create life; you cannot destroy life; you cannot multiply life.

"I believe our bodies are composed of myriads and myriads of infinitesimal entities, each in itself a unit of life, which band together to build a man. We have taken it for granted that each of us is a unit. We think of a cat, an elephant, a horse, a fish and so on as units. I am convinced that such thinking is basically wrong. All these things appear to be units only for the reason that the life entities of which I speak are far too small to be detected even with the ultra-microscope.

"The question has been raised that if these life entities are so small, they cannot be large enough to include a collection of organs capable of carrying on the tasks which I am about to mention. Yet why not? There is no limit to the smallness of things, just as there is no limit as to largeness. The electron theory gives us a reply which is wholly satisfactory. I have had the matter roughly calculated and have at hand the data of the calculation. I am sure that a highly organized entity, consisting of millions of electrons yet still remaining too small to be visible through any existing microscope, is possible.

"There are many indications that we human beings act as a community or ensemble rather than as units. That is why I believe that each of us comprises mil-

(*Continued on page 458*)

Copyright, Thomas A. Edison, Inc.

**Thomas A. Edison—the world's foremost inventor—who is now at work on an apparatus designed to place psychical research on a scientific basis**

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

## Record Weather

To the Editor of the SCIENTIFIC AMERICAN:

In an article in your columns a year or more ago it was stated that a record of temperature by the United States Weather Bureau station at Greenland Ranch, on the border of Death Valley, showed 134° in the shade. In the article "Record Weather" in your issue of August 21st the mark is set much lower than that. It is regrettable to have such discrepancies creep in, for an error in the figure that one happens to know about tends to cast suspicion on all the other figures that one does not know about. A. I. LOOP.

North East, Pa.

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of August 21st it is stated that Fort McDowell, Ariz., holds the record for heat in this country, with a maximum of 119° Fahrenheit, and that the highest known temperature is reported from Algeria at 127.4°. A brief search of the records from 1897 to 1908 discloses seventy-seven records of 120° or more from stations in southeastern California and southwestern Arizona, culminating with 128° at Volcan Springs, Cal., July 9th, 1905, and 129° in the same place June 23rd, 1902. It might also be of interest that temperatures of 110° and more are frequently recorded at Yuma, though this is by no means the hottest station in the region. At Aztec, Ariz., in July, 1905, the average daily maximum for the month reached the astounding figure of 117.9°. H. A. GLEASON.

New York City.

To the Editor of the SCIENTIFIC AMERICAN:

I notice in the issue of August 21st the statement that Cherra Punji, India, has the heaviest rainfall in the world. Sometime ago you published the statement that a spot in the Hawaiian Islands had been found with a heavier rainfall. Which is correct?

Cleveland, Ohio. HERBERT W. ROSS.

To the Editor of the SCIENTIFIC AMERICAN:

In reply to the criticisms called forth by my article "Record Weather," I am afraid I must plead guilty so far as the Greenland Ranch high temperature record is concerned. This record was made on July 10th, 1913, by a fully authenticated instrument, and stands as the highest official mark for this country or any other. I do not yet understand how I missed this, as it was among the Weather Bureau records that were placed at my disposal during the preparation of the article.

As regards the balance of the article, I may say that the Weather Bureau, which receives and files the SCIENTIFIC AMERICAN each week, has filed this copy with two corrections in my article—this one, and another making the West Indian hurricanes occur "usually" between June and October, instead of "always" during this interval, as I had it. Aside from these two items, the Weather Bureau has no exception to take to my article, and I am sure will inform you to this effect if you inquire of them.

While it is true that every statement in the article with these exceptions is true so far as official records go, it is of course equally true that many readings higher than the highest official one and lower than the lowest official one are on record. We all know that the thermometers used by the Weather Bureau are the only ones recognized as accurate, especially in the recording of extremes. At times thermometers will vary by as much as five to eight degrees when hanging side by side. It seems a bit rough to throw out a record which may be perfectly all right, on the mere ground that the thermometer was not properly verified, but the same thing happens in other matters of record every day, and there is really no other help for it. The Hawaiian rainfall record is another case of the same sort. I have no doubt that it occurred substantially as reported, but it is not official and that is all that can be said on the matter.

I may say that there have been recorded, so recently that they are now on the files of the Weather Bureau but were not there when I compiled my article, new world extremes at both ends of the temperature scale. One of these, from Africa, raises the Greenland Ranch record a fraction of a degree; the other, from Western Canada, lowers the extreme mark of officially observed cold to the same extent.

Washington, D. C. WENDELL WHITING.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to your recent paper on Record Weather, the Weather Bureau publishes daily precipitation reports but they do not seem to record what is just as important, particularly just now in California, the daily evaporation per square mile. This would apparently give an indication of climate useful to the farmer and to certain industries.

Vallejo, Cal. C. E. BURNLEY.

## The Time-Space Manifold

To the Editor of the SCIENTIFIC AMERICAN:

The time-space concept clarifies our idea of time which may be defined as a fiction of the finite and three-dimensionally-conditioned intellect, devised to differentiate, locate and dislocate events in the cosmic change and experience. Time is linear and directed; it is therefore reëntrant, an infinity of time being circular and returning upon itself. I infer that hyper-dimensional time possesses qualities of superficiality, such as spreading or stretching; a hyper-dimensional (4 or "n") time-infinity is spherical in three-space and dislocated events or changes in three-space are hyper-dimensionally synchronous.

New York. ALBERT R. GALLATIN.

## The Air Service Corrects Us

To the Editor of the SCIENTIFIC AMERICAN:

On page 253 of the SCIENTIFIC AMERICAN for September 11th, 1920, it is stated that, "the Verville-Packard airplane was designed and built by the Packard Motor Car Company under the guidance of Col. J. G. Vincent." This statement is entirely incorrect, since the Packard Motor Car Company had no part in the design or construction of the airplane, their share in the development being confined solely to the engine. The Engineering Division of the Air Service at McCook Field designed and constructed the Air Service entry entirely in their own shops. The designation is not "Verville-Packard," but should be, "Engineering Division Model V.C.P.R."

In the same issue on page 251 under the title "Making Doubly Sure of the Parachute Jump" occurs the sentence, "If one parachute fails to open, which sometimes happens, the other by all the rules of probability should open." This sentence gives the impression that Air Service parachutes occasionally fail to function. It may be stated unequivocally, that the Air Service parachutes have never failed to open successfully, although an instance is on record where a civilian jumper, in testing a parachute built by a private concern, was saved from certain death by the fact of his having an Air Service standard parachute in reserve.

McCook Field. THURMAN H. BANE,
Major, A. S.

## American Engines

To the Editor of the SCIENTIFIC AMERICAN:

In the September 4th issue of your magazine one of your correspondents makes a statement to the effect that as engine designers the Americans excel all others. A statement of that kind is gross error and calls for criticism.

There are a few things that we Americans should know. We should know that Europe, especially Germany, has developed engines far more efficient than our own. Mr. G. F. Gebhardt, in his *Steam Power Plant Engineering*, says that while the average American 40-horse-power plant has an efficiency of seven per cent, in Germany it runs anywhere between twelve and fourteen per cent. Another thing that we should remember is this: The best American flying machine with two motors, 400 horse-power each, can carry 800 pounds, using fifty-six gallons of fuel to the hour; while a German machine, with a 160 horse-power motor, can carry 1,000 pounds, using seven gallons of fuel per hour!

I believe that no further proof is necessary to convince some of your engineers that there is much to be done before we can boast that we hold first place in engine design. N. T. PELFF.

University of Illinois.

## The Dairy Problem

To the Editor of the SCIENTIFIC AMERICAN:

The dairy presents some peculiar and paradoxical problems. Milk production as a general thing must be followed by an entire community. There must be sufficient production to maintain a receiving station; the withdrawing of a few dairies may close a creamery or cheese factory and force others to abandon dairying.

Milk production and beef-raising are interwoven. About one-seventh of the dairy cows of this State are killed each year. Some of these are young animals that have proven poor producers but most of them are worn out and old. High prices and low prices for beef are equally disturbing: the former encourages the killing of producing cows, and the latter the retention of worn-out animals. Usually the beef value of a cow is only a fraction of the cost of raising her. About three-eighths of a cow's life is unprofitable. The first two years are without any production whatever; the next two are below par, and there is a rest period of about two months each year.

A few years ago much of the milk produced in this State was used in the production of butter. The skim milk was fed to hogs. At present much of the milk is used in liquid form. Where it is skimmed for the cream the skim milk is made into cheese. This means less pork and more cheese. The food value of the cheese from a given quantity of skim milk exceeds the value of the pork.

Jefferson, N. Y. R. C. JONES.

## Caring for the Cone Clutch

To the Editor of the SCIENTIFIC AMERICAN:

On page 297 of your September 25th, 1920, issue you explain partly why a cone clutch becomes harsh, and some of the remedies.

I would like to add that the reason the smooth hard clutch is harsh or "rank" is that it has no high spots to allow it to engage gradually, but on the contrary engages with all its surface and all its power at once or not at all.

The sponging and oiling process is all right but must be followed up by blocking out the clutch when not in use, otherwise the leather is so compressed that it cannot absorb the oil and the effort is therefore wasted.

I would like to add that in my opinion ninety per cent of rear end trouble is directly caused by poorly constructed and poorly operated clutches and that the life of the car might be doubled and the upkeep expense materially lessened by more attention to the proper functioning of this important unit, not only by the designing engineer, but also by reasonable care on the part of the operator.

Hackensack, N. J. S. S. VAN DUSEN.

## Riding the Air in a Balloon Without a Basket

THE national balloon race which started from North Birmingham, Ala., on September 25th, brought out a spectacular feat which we believe gives the lie to the assertion that there is nothing new under the sun. One of the competing balloons, manned by Lieutenants Emerson and Sloman of the United States Navy, in passing over Kentucky was forced to do a good deal of vertical dodging of thunderstorms, its maneuvers including two landings. As a result so much gas was lost out of the big bag that it lacked sufficient lifting power to stay in the race under the usual conditions. The two lieutenants met this situation by cutting away the pilot's basket, and taking the air again, clinging to the balloon rigging above the concentration ring. As if this stunt were not in itself sufficiently perilous, the ingenious ballooners ran into further storms in the Lake Erie region, of such intensity as to render a final landing imperative. In order to effect this landing they had then to slit the fabric of the balloon. They finally came down in an Ohio hay field, after a flight of 37 hours 1 minute, of which 13 hours was without the basket. The distance covered from the starting point was 590 miles, and the extraordinary means employed to stay in the race resulted in the capture of third place by the daring improvisators. It may be remarked, further, that the final landing was made without injury to the operators or the remaining equipment. We hope that this stunt will not become standard practice, but in any event we feel that it well merits the place we have given it on our cover this week.

## A Call for Volunteers

VARIABLE star observing is a little known and yet highly important line of telescopic research work that is worthy of wider publicity, chiefly because it offers to the owner of a small telescope, say of three-inch aperture or larger, an opportunity to contribute observations of scientific value.

The American Association of Variable Star Observers was founded in 1911; it now has a membership of over two hundred, mostly amateurs. During the past nine years its members have contributed and published over 100,000 observations.

The dues of the Association are $2.00 per annum. A cordial invitation is extended to all interested in promoting the advance of astronomical knowledge to join its ranks. The work is entirely visual, not in the least difficult, involves no mathematics, and is of fascinating interest.

Further information and application blanks may be obtained by addressing the Secretary, W. T. Olcott, Norwich, Conn.

# Revising High Bridge

## Five Alternative Official Plans for Doing Away with the Piers that Obstruct Navigation

By W. B. West

THE general outlines of the situation presented by High Bridge, over the Harlem River about opposite West 174th Street, New York, are familiar enough to the readers of the SCIENTIFIC AMERICAN, but may bear a brief recapitulation. The bridge was built nearly three-quarters of a century ago, as a means of carrying the original Croton Aqueduct across the Harlem River; and in fact still forms a part of the water-supply system of the city, though no longer a part of first importance. As a natural consequence of its character, the bridge was built in the multiple-arch type, with five arches (four piers), making up the river span and in addition a number at the ends, especially the east end, to carry the rather high level of the structure back to the high but sloping bank.

**The scheme that stands out, architecturally, as fundamentally distinct from the other four, involving two new longer spans, each replacing two of the older and shorter ones**

**The most ambitious of the suggestions—a single long stone arch span to replace four of the present arches, leaving only one short arch over the river at the east (right) end**

At the time of its building the bridge was distinctly out in the country; and the Harlem River over which it stood was subject to little traffic, and that little largely for pleasure. With the growth of the city and the city's business, the establishment of great railroad terminals at the south end of the river, and the development of Erie Canal traffic, there grew up a very considerable congestion in the Hudson River and about the lower reaches of the Harlem—a congestion which was relieved by the construction of the Harlem River Ship Canal. This passage cuts through the low ridge of rock which separates the Hudson and Harlem River valleys at Spuyten Duyvil and Kingsbridge, and makes the Harlem what the present generation knows it for—less a true river than a strait, similar to the East River, and connecting the Hudson River with Long Island Sound and the great freight terminals of Mott Haven by a route that eliminates the long haul around the lower end of Manhattan Island.

As a consequence of all this, traffic on the Harlem River today is quite heavy, sufficiently so, in fact, to make the heavy stone arches of High Bridge a serious impediment. For the passageway allowed beneath these arches gives the big harbor barges a very small clearance, and it is not unusual for a tow to scrape more or less badly in getting through, while the treacherous currents set up by the very presence of the piers in the river now and then furnish the setting for a real wreck. The War Department, under its control of navigable streams, has long objected to the presence of these piers, but has never brought the matter to an issue. Now it has done so, however, and the city is faced with the alternative of removing or remodeling High Bridge.

**A triple-length span flanked at either end by one of the present arches**

**A single arch in the center of the river, replacing three adjoining units of the present bridge, and reducing the ones at either end to the level of mere ornaments**

**Another suggestion that would place the new triple span at the western side of the river, leaving two narrow arches over the water at the east**

Alike on account of its historic interest and the part which it plays in the water supply—a part small under normal conditions but which might become vital in the event of emergency affecting the deep tunnel from the Catskills — the consensus of opinion is that the bridge should be preserved if possible, and in a form as closely approximating its present one as may be. The additional argument is made that there is no other bridge over the Harlem River between Central Bridge at 155th Street and Washington Bridge at 181st Street, a distance of over a mile. The reason for this is that the streets of Manhattan are separated from the river, throughout this distance, by an upstanding ridge of rock which forms the backbone of Morningside Heights, St. Nicholas, Colonial and High Bridge Parks. Along this particular interval from Central to Washington Bridges the configuration of the ground is such that no effort has ever been made to carry the lateral streets down to the Harlem River; and even on the Bronx side the situation is similar though hardly so extreme. It is argued that in remodeling High Bridge it could be provided with an effective roadway, which it now lacks, and an effective connection with the street system at both ends, which it lacks at the Manhattan end, where only foot-passengers can now leave the bridge.

With the positive action of the War Department, and all these considerations favoring a revision rather than a removal of the bridge, a good many plans have been put forward for eliminating one or more of the stone piers in the river which now support the bridge. Official opinion on the subject, however, has been very slow to make itself heard; and the photographs which we publish herewith are in fact the first public expression of what the responsible members of the city's engineering organization think of the problem.

These pictures are all from the official file of the city's engineers. They are all got up in the same way, by removing from a photograph of the bridge as it now stands the arches whose removal the particular scheme in question contemplates, and drawing in, in their place, the features of the new plan. Of these new plans there are, as will be seen, five from which to choose.

## Getting a Line on Concrete Pipe

By S. R. Winters

WHEN 40 varieties of concrete pipe are being used for irrigation purposes, California alone supporting 150 concrete-pipe manufacturers, the demands for scientific information on the subject are not to be ignored. Strength, imperviousness to an incessant flow of water, and dependability are factors in an irrigation pipe system which insure the transformation of arid barrenness into flourishing areas of vegetation and people. The absence of these qualities may prove costly and retard man's progress in subduing an otherwise fertile territory.

Contractors, engineers, and irrigation managers are annually laying many hundred miles of artificial water routes, not without some trepidation, owing to the lack of specific information as to materials and methods entering into the manufacture of concrete pipe. Home-made equipment frequently isolated from the marts of trade, and a limited output are conditions which have heretofore kept standardization of the finished product in the background. Mounting prices of iron and steel, with a consequent enlarged use of concrete pipe in building irrigation routes, lend emphasis to the efforts of the Division of Irrigation of the U. S. Bureau of Public Roads in standardizing the methods of manufacture of the product.

Coöperating with the Department of Engineering of the State of California, the Federal government about twelve months ago established a field laboratory at Pasadena, Cal., where equipment has been devised and searching tests conducted. Progress in evolving equipment was slow, the machinery and methods being developed along original lines, and only recently were definite results available. The effects of quality of aggregates, grading materials for strength and imperviousness, quantity of mixing water, rock dust and improving water tightness, curing, amount of tamping, and comparison of strength of specimens tested dry and saturated were the angles of contact included in the experiments of the laboratory and yards of nearby factories.

The age-old method of testing the tensile strength of pipe was discarded by reasons of being cumbersome and costly, involving the disposal of huge volumes of waste water. Essentially, this antiquated method consists in the formation of a testing section composed of a number of joints of pipe of the desired diameter, bulkheading each end, the latter being secured by means of a connecting tie rod and then applying water under pressure to the interior until rupture ensued. Substituting therefore, F. W. Stanley and E. C. Fortier of the field laboratory of the Bureau of Public Roads, developed a plan of determining the strength of each joint separately without the use of bulkheads, the joint subjected to the test being influenced by no force other than the water pressure within its shell.

The newly-devised method of testing the tensile strength of the pipe is accomplished by use of a cylinder of galvanized sheet iron corresponding to the length of the pipe joint having grooves at each end, in each of which is inserted a small rubber tube resembling the inner tube of an automobile tire. The cylinder is placed inside the joint of pipe subject to testing and the rubber tubes are filled with water until they press tightly against the inner periphery of the pipe. Water is forthwith admitted into the small annular space between the cylinder and the inside of the pipe. Thereby watertight connections are insured with the same pressure in the tubes as exerted against the concrete pipe. The equipment is portable and can be readily conveyed from one concrete-pipe-manufacturing yard to another where stock pipe can be tested. Likewise the usual

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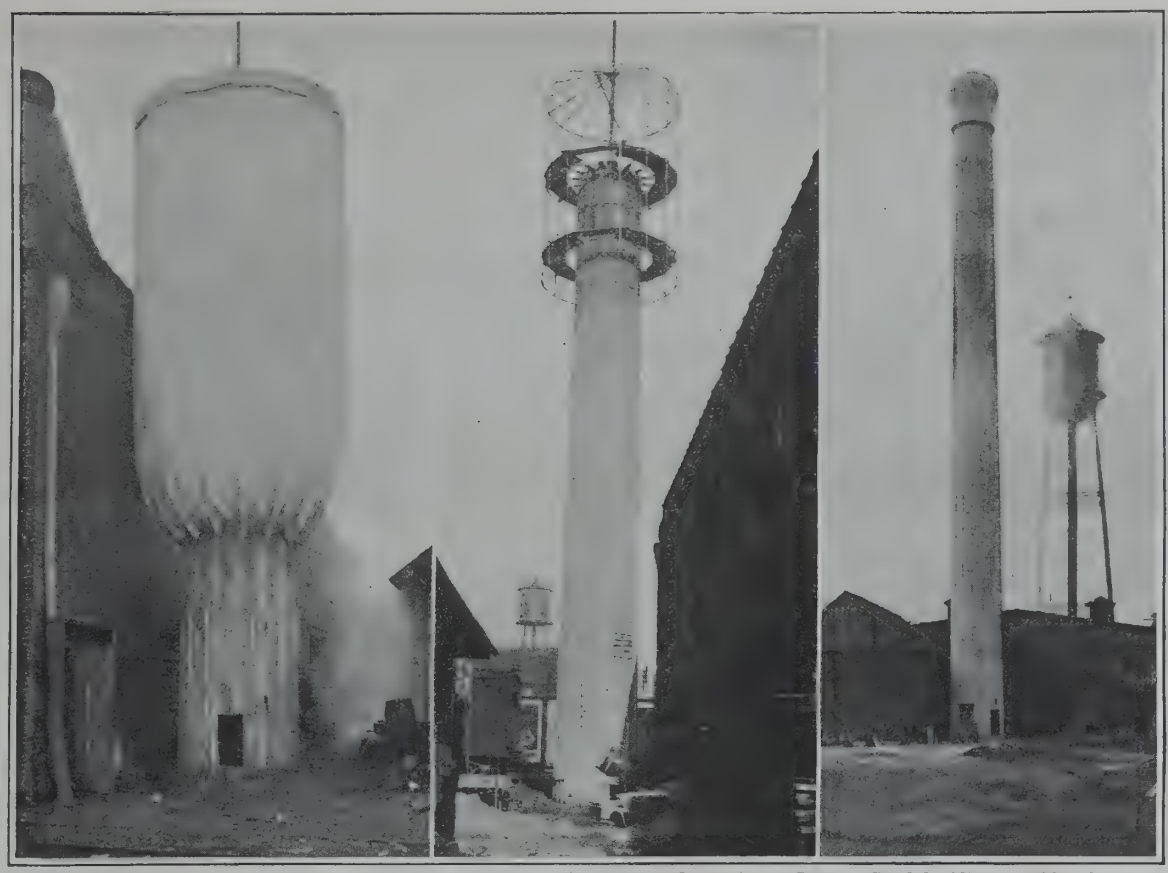

*Left:* Canvas envelope in position, to protect men and work during bad weather. *Center:* Stack-building machine in position for the ninth fill on an 80-foot chimney. *Right:* Finished chimney, showing the flutings that add architectural charm

**Concrete chimneys of character, and how they are built**

## The Architecture of the Concrete Chimney

By G. Orb

IN line with the popular idea that coniform chimneys possess the most pleasing lines, a stack-building machine recently brought out not only adopts this style of architecture but it further ornaments the monolith with a series of vertical and integral ribs which extend the entire height of the structure, dying out in the base of the ornamental top. These ribs are half round in cross section and add strength as well as beauty to the chimney.

The machine used in this class of construction is really a steel cage, carrying the entire construction equipment, and the underlying principle of which is the steel center-mast. This center-mast, with a set of radiating steel tees, makes possible unusual accuracy in every line and absolute uniformity in the taper as the diameter decreases. The overlapping of the wall-forming shells, which are framed in small angles, takes care of this decrease in diameter as the height is increased.

At no time is there any scaffolding in use, either on the inside or the outisde of the chimney, as the workmen use the construction ladder which hangs from the machine. A rib-forming corrugation is stamped in each section of the outer forms; and these forms may be readily removed when it is desired to place reinforcing, thus giving easy access to the work at all times.

The working platforms are carried by the machine itself—the supports of these being elaborated into the steel cage. If the weather conditions are unfavorable, a canvas envelope may be let down over the entire cage and the work proceeds unhindered, with complete disregard for temperature and precipitation.

Due to the rigidity of the machine and the ruggedness of its manufacture it is possible to use the much desired quaky and efficient, though heavy, concrete mix—thus requiring a minimum of materials.

A recently built chimney 5 feet in diameter at the bottom, tapering to 4 feet at the top and 100 feet high, was completed in twenty-one days by four men. The ordinary rate of construction is about six feet per day. The accuracy of construction and ornamentation, as well as the very great reduction in the cost, which the new quipment makes possible, will no doubt do much toward popularizing this method of putting up the big stacks so necessary in modern industry.

**The equipment employed in testing of concrete pipe, and a test carried to the failing point**

# Hardening Steel in Gas Fired Furnaces

## Some Interesting Details of One of the Leading Modern Heat-Treating Processes

By W. A. Ehlers, M. E.

PRACTICALLY all alloy steel used in the manufacture of machine parts and for other purposes where static and dynamic strength is required must have some form of heat treatment in order that it may possess the necessary strength, withstand vibrations, resist impact, have tortional resistance and good wearing qualities when two parts are in moving contact with each other.

This is very well illustrated in the manufacture of an automobile. The gears which are subject to wear must have hardened surfaces or abrasive hardness if they are to run smoothly. The springs must be flexible but not break. The steering mechanism must be very tough and free from brittleness. The crankshaft must withstand the impact of the connecting rods. The front and rear axles must be made to withstand the vibration and shock from the irregularities of the road, and in addition the rear axle must have tortional resistance to transmit the power from the rear transmission to the rear wheels.

Thus it may be said that a steel to meet the above requirements must have a high limit of endurance for the normal stresses and at the same time be able to withstand the abnormal stresses. It is a matter of experience to determine which quality in the steel must be given prime consideration. It also must be remembered that the heat treating process may entirely change the properties of the steel in their relation to the above-mentioned qualities.

Hardness is one of the properties of steel which is probably more often required than any other. It is that property by which the steel resists penetration.

The process of hardening is similar to that of annealing, except that instead of slow cooling, the steel is quenched quickly which causes it to become hardened. There are, therefore, two important operations in this process to be considered—the rate and ultimate temperature of heating, and the method of cooling.

In the hardening operation the same precautions are to be observed as in annealing, viz.: heat slowly and uniformly; do not exceed but slightly the upper critical temperature of the steel being heated. When the steel has thus been brought to the proper temperature the same transition has taken place as in annealing process, that is, the constituents have been changed into the hard structure known as austentite. Upon being suddenly plunged into the quenching bath while at this temperature, the rate of cooling is so sudden that there is little if any further change in the structure of the steel and it then takes the form of austentite, or if allowed to cool slightly it may change back to martensite or troostite.

One of the greatest mistakes made in the hardening room is in attempting to harden steel pieces of any considerable size such as dies in an open coal forge. It must be admitted without argument that such pieces cannot be evenly heated in such fires. Uneven heating will necessarily produce uneven cooling, which in turn will cause uneven strains in the steel, and result in hardening cracks. Gas heated furnaces for heating such steels are far better suited for the work since the rate of heating can be easily controlled and the uniformity of the gas heated oven is all that could be desired. Not only can a very uniform temperature be maintained in all parts of the furnace but the temperature of gas-heated furnaces is subject to positive and automatic control, thus eliminating any tendency to overheating which is very important in heating steels when approaching the critical temperature for that particular alloy.

Heating steels for ordinary hardening can be accomplished in several ways. The most general practice is to use oven furnaces for such work. When this type of furnace is used for high speed steel, the work should be preheated to about 1,100°F. and then placed in an oven having a slightly reducing flame, and a temperature ranging from 1,800° to 2,400°F. according to the character of the tool and the composition of the steel. There are, however, some classes of work which can be better handled perhaps in a liquid bath consisting of molten lead or salts. Small pieces such as typewriter and adding machine parts, spiral springs, cutlery, and long, slender tools such as drills and reamers may be handled better in such bath. This method will not only give uniform heating but there is less chance of overheating and oxidation. Lead, however, is expensive and therefore cannot very well be used for large pieces. It offers many disadvantages such as sticking to the parts immersed, and unless the surface is well covered with charcoal it volatilizes very easily and these fumes are poisonous.

To prevent lead from sticking to the work, cover the tools with a paste made of whiting mixed with alcohol, or dip them in a strong solution of brine.

Heating in salt solutions is very practicable and offers some advantages over lead. Pure table salt may be used, or mixed with chloride of potassium in different proportions and thus almost any predetermined temperature may be obtained. The melting point of the mixture may thus be used as a guide to determine the proper heating temperature.

Barium chloride baths are sometimes used for hardening high speed cutting tools. Its use however has been very much limited on account of the fact that very few operators know enough about handling it to have pronounced success. It consists of a salt melting at about 1,625°F. and is usually heated in furnaces with crucibles. The upkeep cost of such crucibles at the present time make this method almost prohibitive. One of the great advantages in this method of heating lies in the fact that tools having cuting edges do not suffer from oxidation as in other methods of heating, because on removing the tool from the bath a thin film of the solution adheres to the metal and prevents contact with the air. Work which is to be heated in barium chloride should first be preheated to a temperature of at least 1,000°F. before placing in the bath. Frequently this type of furnace is operated at such a high temperature (over 2,200°F.) that pitting of the steel occurs. This may be avoided by carrying out the hardening process at a lower temperature.

The second operation of importance in hardening is the method of quenching. This not only applies to the kind of quenching bath but also to the way the part is handled in the bath.

Cold water, oil, and air offer the best means of cooling the steel. Air, however, can only be considered for such work where scaling is of no consequence or where the work can be ground after hardening.

Brine is used where extreme hardness is desired but unless unusual precaution is taken in having the work heated very uniformly this method is very likely to crack the steel.

Even plain cold water is very severe on the work and like brine may cause trouble on account of cracking. Yet for a great many classes of work this method is preferable. Steel ball bearings are an example wherein extreme hardness is desired and where water quenching is therefore preferable. A majority of the quenching is done in oil baths, particularly high carbon steels, and those used in places where the specimen may be subjected to considerable shock. Spring steel likewise should be quenched in oil. This method

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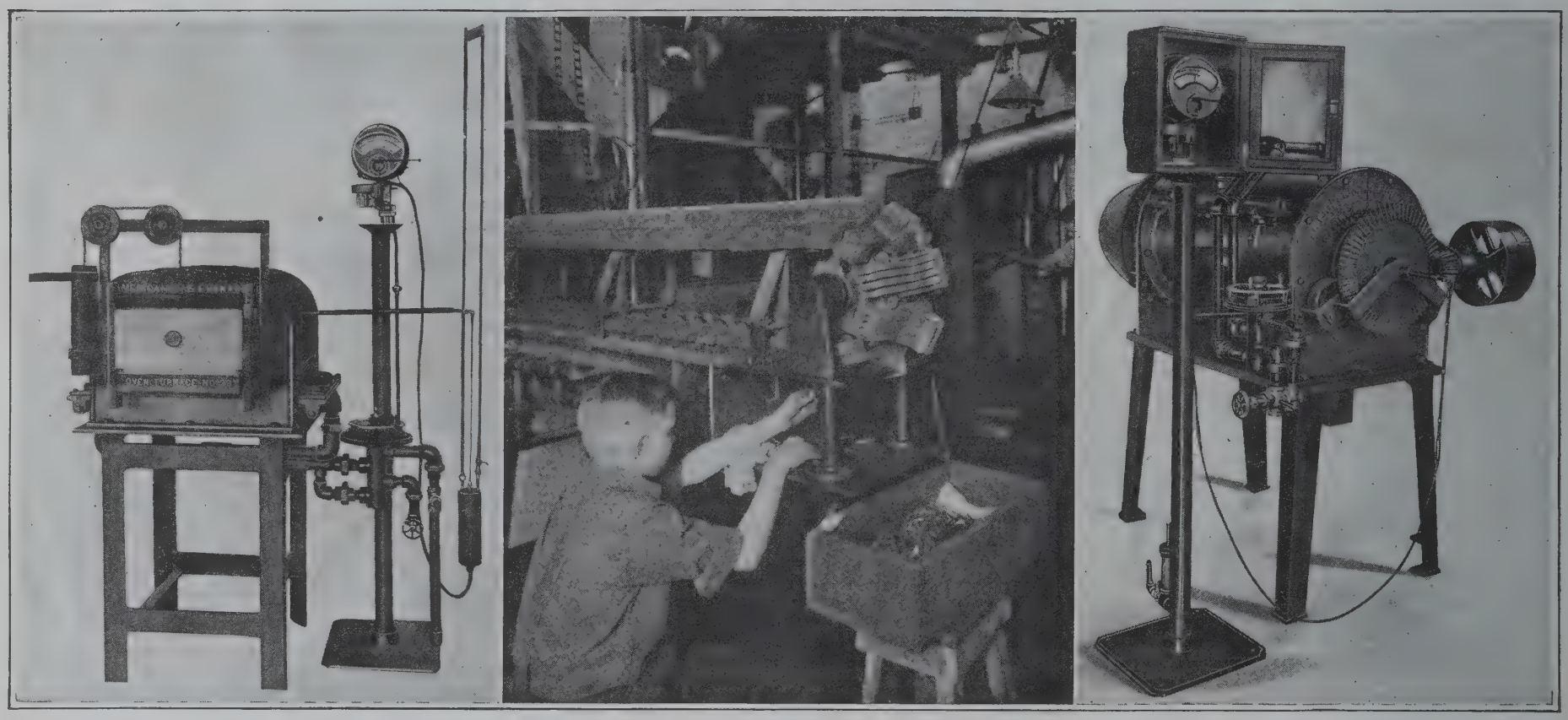


*Left:* Gas-heated oven-furnace, with automatic temperature controller. *Center:* Gas-heated automatic continuous hardening-furnace for pocket-knife blades. *Right:* Another type of hardening furnace with the automatic temperature control.

**Some representative furnaces in which gas heat aids in the hardening of steel**

## The Last Race for the Gordon Bennett Cup

**By John Jay Ide**

THE Sixth Gordon Bennett Aviation Cup race took place near Etampes, France, on Tuesday, September 28th. It was won by Sadi Lecointe on a French Nieuport biplane equipped with a 300-hp. Hispano-Suiza engine. As this was the third consecutive time that the cup had been won by a French pilot it now passes permanently into the possession of the Aero Club de France.

The contest was held over a 50-kilometer course extending from the aerodrome of Villesauvage to La Marmogne. Three rounds of this course had to be covered, making a total of 300 kilometers (186.45 miles). On the previous Saturday a race of 100 kilometers to determine the three French entries had been held. This had resulted in the elimination of Casale (Spad) and Barrault (Borel), leaving Sadi Lecointe and Kirsch (Nieuports) and de Romanet (Spad) qualified.

To represent the United States the contest committee of the Aero Club of America chose one of the two Curtiss machines brought over by Mr. Cox, the Verville biplane entered by the Army Air Service, and the Dayton-Wright monoplane. The pilots of the American entries were Rohlfs, Captain Schroeder and Rinehart, respectively.

England was to be represented by a Sopwith biplane (Hawker), the Nieuport "Goshawk" (Tait-Cox) and the Martinsyde "Semi-quaver" (Raynham).

The Curtiss was wrecked in landing on the rough aerodrome at Etampes Sunday evening after flying down from Villacoublay where it had been assembled. The pilot, Rohlfs, was rather badly injured but was able to leave the hospital to see the cup race. Of the English entries the Sopwith never appeared owing to the collapse of the Sopwith Co. a few days before the race, and the Nieuport arrived too late.

The actual starters, therefore, were:

*France*—Sadi Lecointe (Nieuport, 300-hp. Hispano-Suiza); Kirsch (Nieuport, 300-hp. Hispano-Suiza); de Romanet (Spad, 300-hp. Hispano-Suiza).

*America*—Captain Schroeder (Verville, 600-hp. Packard); Rinehart (Dayton-Wright, 250-hp. Hall-Scott).

*England*—Raynham (Martinsyde, 300 hp. Hispano-Suiza).

During the morning the course was covered by a fog which did not begin to clear off until noon. It was thought for a time that the race would have to be postponed until the following day but after several test flights had been made it was decided that it could commence.

The French team had been taken out on the field at about 11 o'clock and had their motors tested, etc. De Romanet's Spad appeared with a new fin and rudder put on overnight, the old ones having proved too small for proper lateral control. While on the field the standard wheels of the Spad were replaced by those of the racing variety having tires and wheels completely enclosed in fabric casings.

The American and British machines were wheeled out of their hangars at about one o'clock. The former joined the French group on the field but the Martinsyde for some reason occupied an exclusive position about 300 yards away.

In the middle of the preparations for the start Tait-Cox arrived in a British Nieuport "Goshawk," bursting a tire on landing.

The first man to start in the race was Kirsch, who crossed the line at 1.36.25. He was followed by de Romanet at 1.44.52. Sadi Lecointe started at 2.8.54 and Rinehart at 2.11.10.

Great difficulty was experienced in starting the engine of Captain Schroeder's Verville and as the rules state that the contestant must cross the line within half an hour of the starting time he has chosen some anxious moments were passed by the American contingent. Finally the Verville got away just within the time limit at 2.37.2. The British contender did not leave until all other competitors had either finished or abandoned the race, waiting until 4.34.36 for absolute calm and cooler atmosphere.

Kirsch, the first starter, made the best time over the hundred kilometers (62.15 miles) which he covered in 21 minutes 29 seconds. Toward the end of the second lap, his engine began to miss and he abandoned the race after completing 200 kilometers (124.3 miles) in 48 minutes 52 1/5 seconds.

De Romanet ran a fine race against heavy odds. Near the end of the second lap an oil pipe broke, covering the pilot with lubricant. He landed at the aerodrome, made a hasty repair and took the air again, completing the race in 1 hour 39 minutes 6 3/5 seconds. De Romanet's time for 100 kilometers was 22 minutes 52 seconds and for 200 kilometers 46 minutes 7 seconds.

Sadi Lecointe, the French favorite, gave all spectators the impression of consummate skill. After taking off he flew around until he succeeded in obtaining perfect carburetion. Following this he rose to about 3,000 feet to pick out the most direct line to the other end of the course. He then descended to about 40 feet from the ground, crossed the line and in a few seconds disappeared on the horizon without, apparently, having deviated a foot from the course he had set himself at the start.

Lecointe's piloting on the turns aroused great enthusiasm. His system was to bank the machine several hundred yards before the line. Just before reaching it he would kick the rudder hard over, centrifugal force carrying him beyond the line in a turn approximating the vertical, the machine cutting the line again within three seconds. In less than a hundred yards the Nieuport would be on an even keel again speeding toward La Marmogne. The finishing line was crossed at a bare ten feet above the ground, the 300 kilometers (186.45 miles) being covered in only 1 hour 6 minutes 17 1/5 seconds, thereby creating a new world's record. The old record (2 hours 51 minutes 53 4/5 seconds) had been held by Tabuteau ever since January 21, 1912. Lecointe's time for 100 kilometers was 21 minutes 36 3/5 seconds and for 200 kilometers 43 minutes 42 3/5 seconds. Lecointe's time for 200 kilometers is also a new record, the old one having been made by Prévost in the last Gordon Bennett Cup race September 29, 1913 (59 minutes 45 3/5 seconds), also witnessed by the writer.

Meanwhile the two American entries had made very disappointing exhibitions, the Dayton-Wright having landed at the expiration of twelve minutes. It appeared that the top threads of the worm shaft controlling the hinged leading edge of the left wing (one of the novel features of this machine) had stripped causing the edge to flap when in the high speed position. This, of course, rendered the machine uncontrollable.

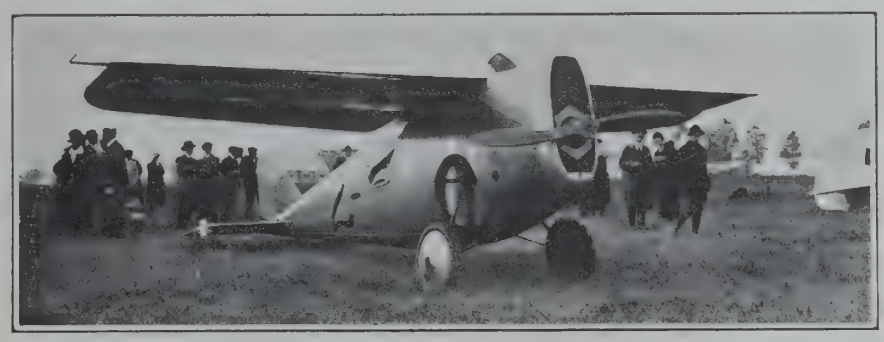
Captain Schroeder was forced to return when almost at the other end of the course on his first round due to motor preignition caused by insufficient radiator surface for the very warm day. The Verville gave an impression of tremendous speed and it is most regrettable that the enterprise of the Army Air Service in designing and in sending over this remarkable machine did not have a better reward. The design work has by no means been lost, however, as with a few alterations the Verville can be turned into a pursuit machine second to none.

Raynham, who, as noted above, did not start until after half-past four returned to the aerodrome before he had completed 100 kilometers owing curiously enough to a similar mishap to that of the de Romanet—breakage of the oil feed. Raynham's Martinsyde is the identical machine which won the Aerial Derby around London last July. It is a smaller edition of the Martinsyde Scout—the fastest British single seater produced during the war.

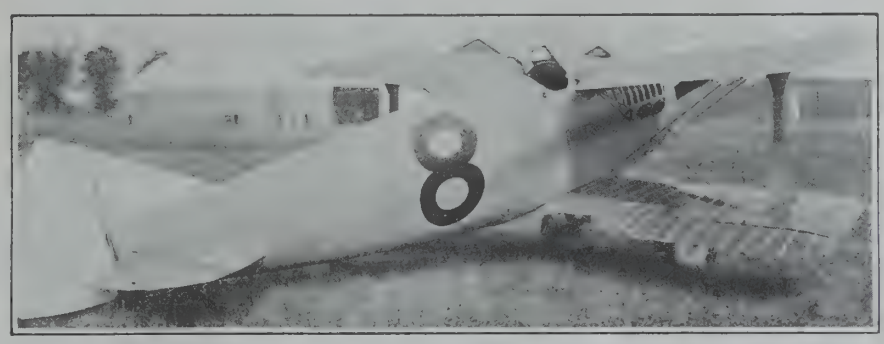
The Spad entry was a standard model 20 with reduced wing gap and with a cover, carrying a fairing for the pilot's head, over the observer's cockpit. The performance of de Romanet therefore greatly redounds to the credit of M. Herbemont, the designer of the machine.

The Nieuport machines are a development of the model 29C1, which would have been adopted as the standard pursuit airplane by the French Army had the war continued. The Gordon Bennett models however are much smaller than the 29C1 type, having only one pair of struts on each side of the fuselage.

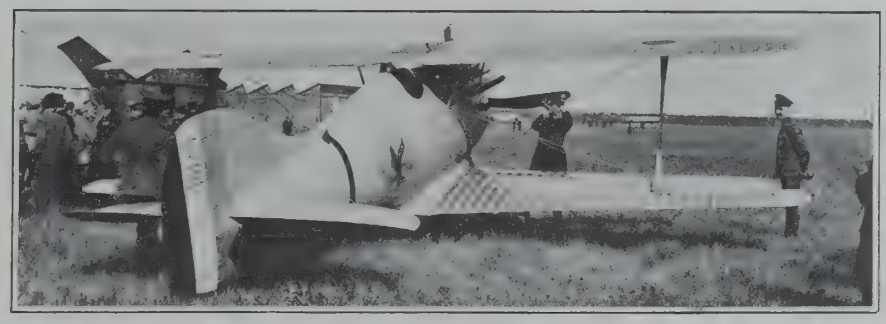
**Nieuport biplane with 300-horsepower Hispano-Suiza engine, piloted by Sadi Lecointe, the winner of the race**



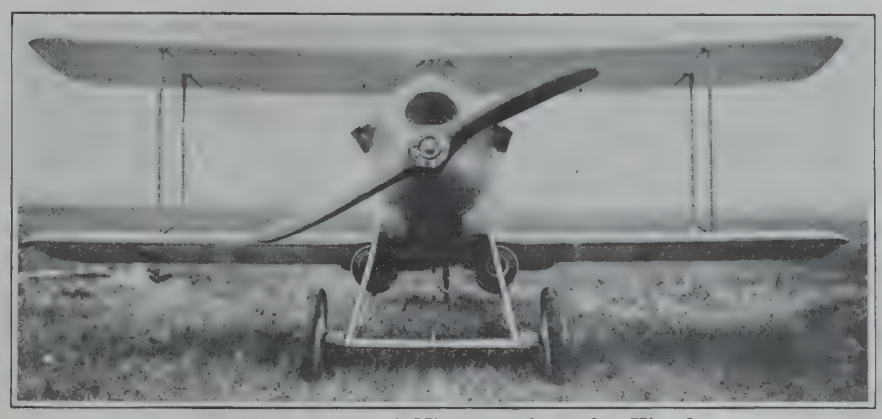
**The American Dayton-Wright monoplane which was the most novel machine entered in the race**



**The Spad biplane of DeRomanet, showing enlarged fin and rudder. This machine finished second in the race**



**Another American entry, the Verville, showing changes in tail**



**Front view of Nieuport flown by Kirsch**

# The Heavens in November, 1920

## Accumulated Data on the Distribution of Stars in Space

By Professor Henry Norris Russell, Ph. D.

A PAPER of more than usual interest has just been published by the Dutch astronomer, Kapteyn. For many years this distinguished student of the stars has devoted his unflagging energy and keen insight to the collection of information about the brightness, motions, and distances of the stars—all with one great purpose consistently in view: the determination of the structure of the stellar universe. How thickly are the stars scattered in space? What proportion of them is bright, and what fraction faint? Does the starry region extend indefinitely far in all directions, or is it limited and surrounded by relatively, if not quite, empty space? If so, what is the shape and size of the star-filled region? Is it sharply bounded, or does it thin out gradually at the edges? These, and questions like them, have been the problems to which Kapteyn has devoted his researches; and at last, after years of labor, aided by the coöperation of observers at many places, and of skilled assistants, he and his associate, Dr. Van Rhij'n have found themselves ready to give out preliminary answers.

Space would fail us here to tell the tale of how these answers were obtained. Suffice it to say that the methods were mainly statistical—determining the number of stars in the sky which appear to us of each stellar magnitude; then finding out what percentage of the stars of each magnitude had proper motions between given limits; proceeding from this to estimate what fractions of the whole number lay at different distances from us—and so on—with a multitude of minor but still important and difficult problems coming up, now and again, which had to be solved before the main work could be completed.

The results, however, are easily enough understood. In presenting them here, we will translate the technical but unfamiliar terms "absolute magnitude" and "parsecs" into the more generally familiar ones of brightness compared with the sun, and distances in light-years.

### Our Sidereal Neighborhood

Within a hundred light-years of our sun, the stars appear to be scattered with fair uniformity in space. The number which lie within this distance, according to Kapteyn's new calculation, is 6,200. If we limit ourselves to half the distance, we should expect to find, not half as many stars, but one-eighth as many, since the region in space within which we are looking for them is a sphere with only half the diameter of the one we had at first, and hence contains only one-eighth as many cubic light-years. Only one in a thousand of the 6,200 stars should be within ten light-years of us—that is, six in all. Four stars are actually known to be nearer than this—Alpha Centauri, Sirius, Barnard's "runaway" star, and the seventh magnitude star known as Lalande 21,185; and two or three others are so near the limit that we can hardly say whether they are inside or outside it. Then we must not forget the sun itself, which is a star essentially similar to the others; and so we have in all six or seven stars within this region of space, in perfect agreement with Kapteyn's calculations—though in the case of so very small a sample of space, so close an agreement is probably a matter of good luck.

But even among these nearest neighbors of ours we find enormous differences of real brightness. Sirius is more than twenty times as bright as the sun; Barnard's star gives out only 1/2500 of the sun's light. How is it among the stars in the wder field which Kapteyn has made his own?

His calculations show that a surprisingly definite answer may now be given. The great majority of stars in any given region of space are fainter than the sun, and really bright stars are rare. For example, out of the 6,200 stars nearer than 100 light-years, 790, or only one-eighth of the whole number, may be expected to exceed the sun in brightness. About 100 of these will be ten times as bright as the sun, or more; and only five or six will exceed 100 times the sun's brightness. Only one star in 50,000, on the average, is 1,000 times as bright as the sun, so that we would not expect to find such a star as near as 100 light-years. We can be sure that there is actually none, for at this distance a star 1,000 times brighter than the sun would look to us brighter than Vega. There are only three stars in the sky brighter than this. Two of them, Sirius and Alpha Centauri, are very near us and of moderate real brightness; the third, Canopus, is certainly more than 1,000 times as bright as the sun and certainly more than 100 light-years away.

But we have said nothing yet about the stars fainter than the sun, though these constitute the majority of the whole—5,410 out of the 6,200 stars aforesaid. About 3,400 of these will give out less than one-tenth as much light as the sun, leaving some 2,000 in the intermediate region of brightness; and of the 3,400, 2,200 will be found to possess a luminosity between ten per cent and one per cent of the sun's.

Among the remaining 1,200 still fainter stars, objects of very small luminosity appear to become rare. Some 200 of them are less than 1/1000 as bright as the sun. Our information about these very faint stars is still scanty; but according to Dr. Kapteyn's present data, only a dozen will be less than a ten-thousandth of the sun's brightness.

At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

At 9½ o'clock: November 30

NIGHT SKY: NOVEMBER AND DECEMBER

### Some Apparent Paradoxes

According to this census of the stars, we may therefore regard our sun as a pretty bright object, surpassing seven out of eight of his fellows. But how are we to reconcile this with the fact—demonstrated securely by direct measures of parallax—that the majority of the brighter stars in the sky are much more luminous than the sun? This apparent paradox arises because the stars visible to the naked eye—or, for that matter, above any assigned limit of *apparent* brightness—are not a fair sample of the whole, but are hand-picked (or it would be better to say *eye-picked*) to an amazing degree.

Let us compare, for example, the stars which are between 10 and 100 times brighter than the sun with those which are between 10 and 100 per cent of the sun's brightness. We found above that there were 2,000 of the latter class within 100 light-years of us, as against a little less than 100 of the former—a disparity of twenty to one. The stars of the brighter group, even if at the limiting distance, would *all* be easily visible to the naked eye as stars of the fifth magnitude or brighter. But those of the other group, if at a distance of 100 light-years, would appear as stars ranging from the seventh to the tenth magnitude, and so would not get into our list of naked-eye stars at all. Only a few of them, which are less than twenty light-years away (or ten light-years, for the faintest members of the group) will be easily visible to the naked eye; and these will be but a beggarly fraction of the whole number.

Speaking more generally, the stars of the first group, on the average, are 100 times as bright as those of the second. We can therefore see them at ten times the distance, and we will be hunting for them throughout a region of space a thousand times greater than that to which our search for stars of the other group is limited.

For every star of the fainter sort which gets into our list of naked-eye stars, there will therefore be fifty stars of the brighter kind—and a thousand of the fainter sort which, though no farther away from us than the brighter ones which we have listed, are invisible to the naked eye.

This thousand-to-one preference, converting a real minority of five per cent into an apparent majority of 98 per cent, is not at all an exaggerated example of the effects of observational selection. In some cases, as between stars like Vega and Arcturus and objects like Barnard's star, the preference would be a million to one—so that it is not surprising that only one isolated star as faint, in reality, as Barnard's has been discovered among the half-million or so stars brighter than the tenth magnitude.

Closely allied with this effect is another curious and half-paradoxical fact. The total amount of light given out by the 6,200 stars which we may, by stretching our definition of neighborhood somewhat, call our neighbors in space, comes out 6,500 times the sun's light; so that the average amount of light given by one star is very nearly equal to that of the sun. But a simple calculation shows that 87 per cent of the stars, which are fainter than the sun, give out only 12 per cent of the total light, the remaining 13 per cent giving out 88 per cent of the total. The stars which are more than 15 times as bright as the sun, though numbering only one per cent of the whole, give out half of all the light. Such considerations illustrate what extraordinary differences will appear in our point of view and in the results which we obtain, according as we count the stars as they appear in the sky, or measure them by their light-giving power. The novice will find many pitfalls in such statistical studies, and even the well-equipped student, if not explicitly on his guard, may be caught. It need hardly be added that such effects have been very carefully allowed for in Kapteyn's monumental work.

### The Heavens

Turning to our star-gazing, we find Orion high in the southeast, with Sirius below, Aldebaran and the Pleiades above, and Procyon on the left. Perseus and Auriga are overhead, Gemini high in the east, and Leo rising. Ursa Major is low in the northeast, and Ursa Minor and Draco in the north. Cassiopeia is high in the northwest, and Cygnus is setting far below. Pegasus is well up in the west, with Andromeda above. Cetus and Eridanus occupy the great dull region in the southwest.

### The Planets

Mercury is an evening star before the 16th, and a morning star afterwards, but is visible only at the very beginning and end of the month. Venus is an evening star, but is still very far south, and sets before 8 P. M. Mars is an evening star, too, and sets about an hour and a half after Venus.

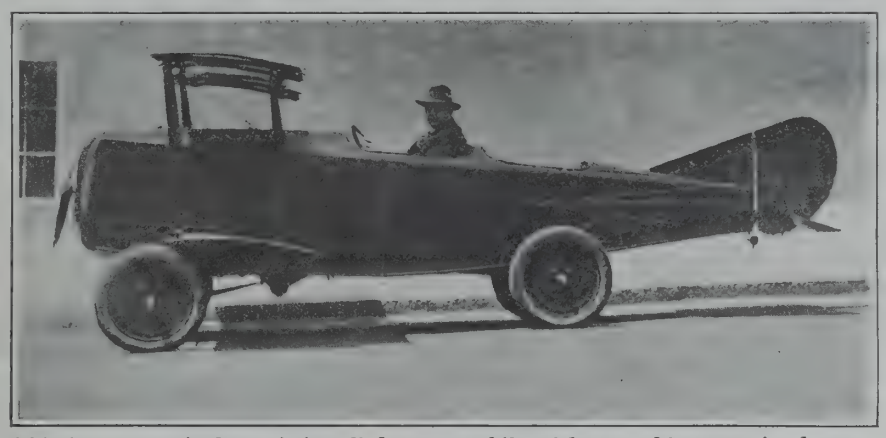
(*Continued on page 460*)

## An Airplane Not Built to Fly

THE accompanying illustration shows an airplane built on a light car chassis by a San Francisco automobile company. The machine is used as a stunt; that is to say it is an advertising car and not a flier.

The propeller of this novel airplane that never leaves the ground may be operated from the engine of the car if desired. The machine is built exactly on the lines of an airplane, being provided with rudder and elevators, the rudder being connected with the steering wheel by means of cables in such a manner that the rudder turns to the right and left as the steering gear is manipulated, thus acting as a direction indicator to the motorists in the rear.

The elevators are operated by the controlling lever as in an ordinary plane, and when the car is brought to a standstill the elevators are lowered in the same position as on a plane when descending. The car is equipped with airplane tires with special tread in the rear to conform with the narrowness of the body toward the rear. The car carries port and starboard lights controlled by a switch. The car is a two-seater.



**This is not an airplane; it is a light automobile with something new in the way of a freak body**

## A Ferryboat Built on Motor-Boat Lines

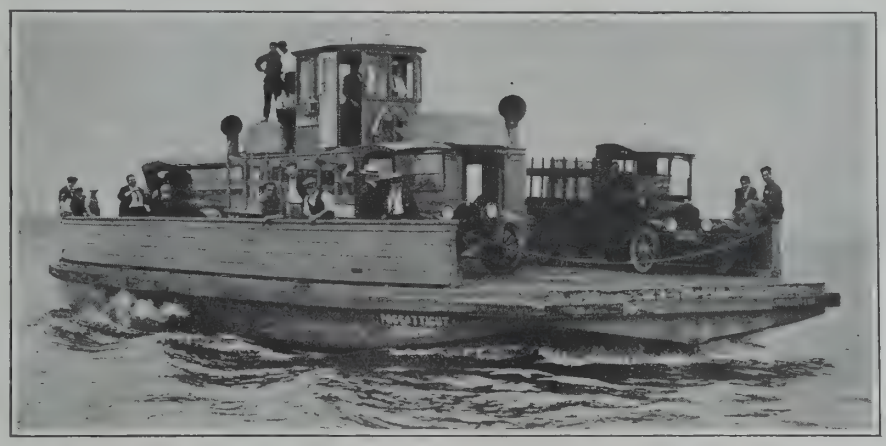
BECAUSE of the limited traffic to be handled, a gasoline engine is being used in connection with the ferryboat "Poggatticut," which operates between Greenport and Shelter Island Heights, at the eastern end of Long Island, N. Y. This boat makes round trips twice an hour, accommodating eight automobiles on uncovered runways alongside the central passenger cabin. Licensed for one hundred passengers, she is operated by a gasoline engine and a two-man crew consisting of the pilot-engineer and a deck hand. Truly, this is economical operation and quite in keeping with the limited traffic.

The "Poggatticut" is 64 feet long, 28 feet overall beam, 4 feet 11 inches draft loaded, with a gross tonnage of 72.6 and a net tonnage of 57. This ship is constructed with straight floors from keel to bilge corners, with the fore and aft treatment carefully worked out. Indeed, she makes scarcely a ripple when traveling at eight miles per hour.

The operation of the ferryboat is entirely from the pilot house, which is equipped with engine and clutch controls. This house is directly connected with the engine room by a vertical ladder shaft with a sliding door opening to main deck runway, and has a door on each diagonal side to the boat deck where two wooden ponts, equipped as life boats and totaling the required life-boat capacity, are checked bottom up.

The power plant is extremely novel, comprising an automatic 50-horse-power double flywheel engine, with a one-way clutch at each end connecting to the continuous-line shafting with a propeller at each end. The forward propeller runs idle while the boat is being driven forward, but comes into play when a reverse action is wanted. The rudders are fitted with locking pins and protected by an armored ram for operation in ice of reasonable thickness.

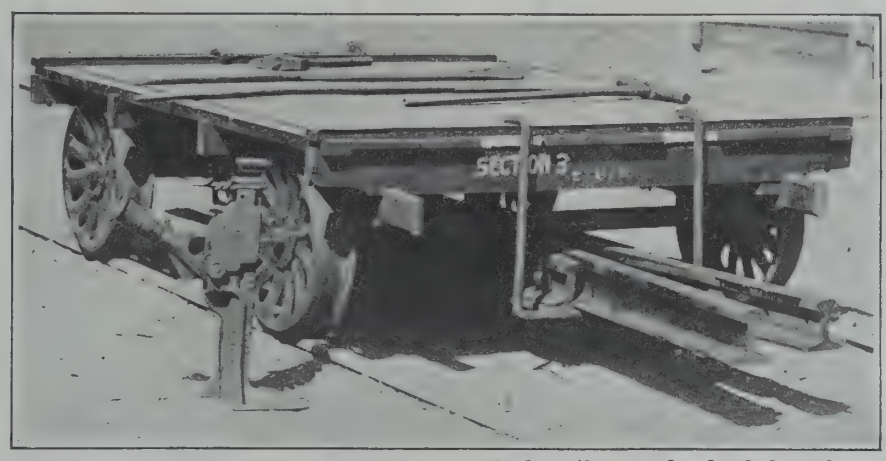
The remarkably steady running and maneuvering qualities of the "Poggatticut" are its strongest talking points, since the heavy tides encountered on her route call for an extremely manageable craft.



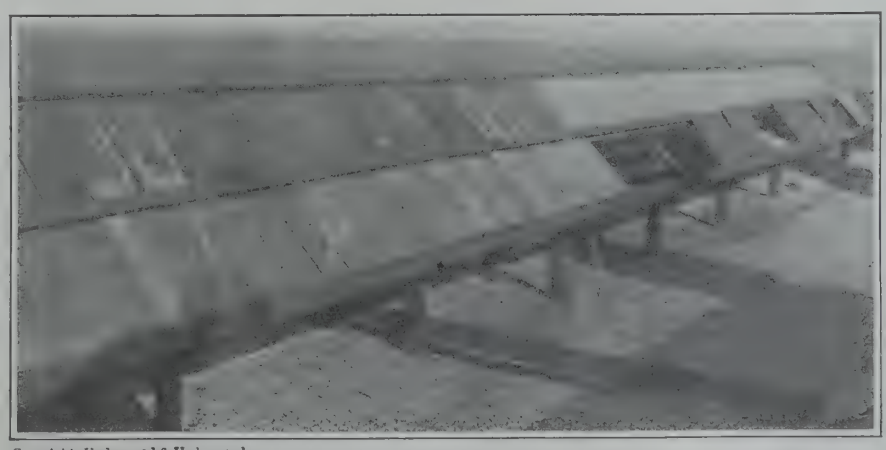
**The "Poggatticut"—a two-man ferryboat which carries 100 passengers and eight automobiles**

## Loading Rails With a Jack

THOSE who have to do with the handling of lumber have, in many instances, discovered that these shapes, long and narrow to the last degree are frequently best manipulated with the aid of an underslung carriage of some sort; and the SCIENTIFIC AMERICAN has on several occasions described and pictured such appliances. A new member of the family now comes to our attention, the invention of Mr. Arthur Vinet of Winnipeg. This time the intent is to facilitate the handling, not of lumber, but of another shape equally long and if anything even narrower—railroad rails, frogs, etc. It will be noted in the picture, which really tells the story of Mr. Vinet's invention, that the hooks forming his underslung carriage are not a permanent feature of the flat car on which they are installed, but that they can be removed from and added to the car almost as easily as the rails can be loaded on and unloaded from the hooks themselves. The procedure for loading, after placing the rail or frog to be loaded in the center of the track, is to run the car over it, put a track-wrench through the bolt holes at either end of the piece to be loaded, jack up the ends of the frog until it reaches the axles of the car, and then place the hooks. The idea has proven so good in practice that Mr. Vinet's invention has been installed in the Canadian Pacific terminals throughout Canada.



**The temporary underslung carriage on which rails can be loaded with no other tool than a jack**



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**Paint racks on roof of Chemistry Building of the Bureau of Standards at Washington, D. C.**

## Where Age Improves Germination

THE seed of some garden vegetables is never saved by amateurs for the reason that the plant is a biennial, and doesn't make seed until the second year. Cucumber seed is seldom saved probably for another important reason and that is the germination factor. Cucumber seed only a year old is characteristically poor seed. Germination improves with age. Seed houses never plan to sell cucumber seed which is not at least two years old. Seedsmen, as the professional gardener is perfectly well aware, know that cucumber seed is at its best at three years; that it is excellent at five years. Not only does aged cucumber seed have higher germination, but it produces much stronger plants. Plant cucumber seed fifteen or even twenty years old, and a great deal of it often will come up.

As in the case of cantaloupes, the cucumber seed business of the United States is largely in the hands of expert growers who control large acreages. Some of the big growers have as much as 200,000 lbs. in storage at one time. The warehouse is mouse-proof and fire-proof, and so that they may guarantee seed free from disease the cucumber specialists disinfect it.

Here, as in many other fields of agriculture, constant experimental work is the price of progress. Corrosive sublimate is the agent used in treating seed. In doing this for a long time many growers dissolved the poison in cold water until an expert showed them that either hot water or wood alcohol must be used to make the solution. Corrosive sublimate "dissolved" in cold water simply sinks to the bottom.

Another little point that had to be worked out was the strength of the solution. The proper percentages of corrosive sublimate, it has been determined, is 1-1,000. A proportion of 1-200 will kill all the seed, 1-400 most of it, 1-600 some, 1-800 a little.

Rinsing the seed is an operation which has led to ingenuity. Formerly the practice was to rinse it for a long time in running water; most growers do now, in fact. One of the largest operators introduced a better method. He uses a little lime water, and the work of rinsing is radically reduced.

## Putting Paint to the Acid Test

THE untiring Bureau of Standards has recently undertaken to test paints on a scientific basis; or, in other words, to take the guess work out of paints. For paints are used as much or even more for preservative purposes than for decorative purposes, and something definite should be known in advance regarding the wearing qualities of any paint.

A series of racks has been erected on the roof of the Chemistry Building of the Bureau of Standards, as shown in the accompanying view. On these racks are placed slabs or panels of wood and metal, coated with the paints and varnishes to be tested. The slabs or panels are exposed at an angle of 45 degrees to the vertical facing south so as to get the most severe exposure. In this manner the paints and varnishes are subjected to the most extreme conditions that would be encountered in normal use, and the experts of the Bureau are enabled to gage with considerable accuracy the wearing qualities of various paints and varnishes. Not only does the Bureau test the samples submitted by manufacturers, but the very elaborate paint shop of the Bureau is carrying on important research work in the way of guiding all efforts toward better paints and varnishes.

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

A handy tool for the repair of unwieldy truck tires

## Electric Buffer for Truck Tires

A HANDY tool for shop or garage use in repairing truck tires is the equipment shown here. The equipment consists of bench stand with flat pulley, five feet of shafting, spindle and scratch brush. The equipment can be driven from the line shaft or from a motor as shown. It is said to do efficient and economical work.

## Trunk with an Ironing Board

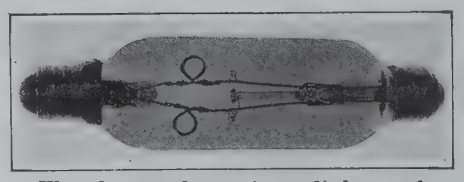
WARDROBE trunks were thought to be the last word in traveling equipment when they were first introduced a few years ago. The various compartments for wearing apparel were then as convenient as the makers knew how to make them. But a 1920 model wardrobe trunk made by a Chicago manufacturer would make the old models shiver with shame. The newer trunks have made use of the pressure board, used to keep the wrinkles from garments hung upon the hangers, as an ironing board combination. This board, used formerly for but one purpose, now serves two. Upon one side it is padded and has the outer end rounded so that the owner can easily press the shoulders of shirts or blouses. The firm foundation is possible because of the upright support which clamps to the outer end.

Various other improvements are also found in the trunk, such as collapsible hat boxes, shoe compartments, electric iron space, umbrella and cane rack, not to mention an improvement in locking. By a single motion of the hand on the top locking device, two other locks located below are secured at the same time. This eliminates stooping over to fasten the lower locks.

A wardrobe trunk equipped with an ironing board

## Light and Power from a Single Bulb

A TWO-BASE incandescent globe has been designed by E. O. Schmeitzer, an electrical engineer of Chicago, Ill. With this globe it is now possible to have light and power from the same socket without connecting a double base socket. The new globe is simply connected in the old way and any heating device that might be wanted for use such as a cold water warmer, electric iron, etc., is connected to the end opposite. The design of the globe has been changed somewhat to a cylindrical shape with a tipless end. The exhaustion of the bulb has been carried out by means of a sealed-off tube concealed within one of the bases. The lead wires are given a quarter twist in passing between the two ends of the lamp to provide clearance for the filament anchors. Old designs of electrical devices used in the home can now be



The lamp that gives light and power at the same time, auxiliary apparatus being connected at the "other end"

quickly and cheaply changed to provide more harmonious lighting effects. What is known as a "pendant" fixture can be converted into a semi-indirect fixture by the use of the new lamp.—By *K. H. Hamilton.*

## New Sources of Power Alcohol

THE opinion gathers force that there are ample sources of the raw materials of power alcohol available in regions where the difficulties in connection with the transport of plant and machinery required and of the product to the consuming centers are not so great as in some of the areas which have been marked out as ideal raw material producers, according to the *Times Trade Supplement.*

It is reported that in the Pacific Islands alone, maize, cassava and sugar cane could be grown and utilized to an extent which should produce 50,000,000 gallons a year, and it is suggested that the world demands could be filled by the raw material available within certain Empire areas. Estimates of the cost of obtaining industrial alcohol from the crops named indicate that 6d. per gallon is a figure which could be realized, and the process of distillation should be associated with the recovery of valuable by-products.

## Floating Fair from the Netherlands

A COMPANY has been organized at The Hague for the purpose of sending a "floating fair" as it is called, but practically a ship loaded with sample products and commercial agents to sell them, to various parts of the world, particularly the United States. The concern is organized somewhat on a coöperative basis and proposes to send the Messageries Maritimes vessel, the "Macedonia," of 6,100 tons burden to the United States and Central and South America for the purpose of introducing Netherlands products and enabling Netherlands commercial houses to establish import and export connections in the countries visited.

The plan is for each of the Netherlands firms going into the scheme to advance the sum of 2,800 guilders or, at present exchange, the equivalent of $861 American currency, for each cubic meter of space occupied aboard the vessel by an exhibitor and 200 guilders or about $61 gold for each port visited. The ship will be divided into show rooms and each exhibitor will instal aboard the vessel in the space he engages such a display of his goods as he cares to make and will furnish the company with advertising matter, price lists, and other information. The company will furnish an organization of commercial men on the ship which will act as sales agents and will endeavor to arrange satisfactory permanent connections for the exhibitors in the ports visited. For sales actually made the company will charge a single commission of 10 per cent, taking no commission on the business which follows from connections thus made. It proposes to carry on a comprehensive advertising campaign in the countries to be visited so as to secure the maximum result from the visit.

## New Lathe Dog with Safety Feature

A LATHE dog being manufactured by an Ohio firm is fitted with a recess into which the set screw head fits and the danger of breaking projecting set screws is eliminated. Extra metal used in forming the recess serves to balance the dog. The screw of the dog is set with a socket wrench.—By *Allen P. Child.*

Setting the screw of the safety lathe dog with a socket wrench

## Restoration of the Belgian Railroads

TRADE COMMISSIONER SAMUEL H. CROSS reports from Brussels, Belgium, under date of August 25, that the severely damaged railroad section from Mons to Ghlin has been completely rebuilt, and the bridge over the Lys just outside the St. Pierre station at Ghent has lately been opened for double-track use. The Alost-Opwijk-Londerzeel and Dixmude-Nieuport lines are nearly ready for operation, while the Courtrai-Menin line is open as far as Warneton. Interlocking block systems have been installed between Brussels and Antwerp and between Brussels and Ostend. A similar system is in process of installation on the Namur-Sterpenich route. Purchases of equipment are being made for the restoration of the electric switch systems in the larger stations. The central shops are repairing 12 locomotives per week, as against 19 in 1914, while the section shops have reached 50 per cent of their pre-war efficiency.

To protect the cotton-picker's fingers

## Finger Guard for Cotton Picking

ONE of the latest inventions for use in the cotton fields is a very simple cotton picker, consisting of a piece of flexible metal that is adjustable to fit the finger. It fits securely over the first joint of the finger, one to each finger. On the inside it has five small cleats to give tenacity. Experienced pickers declare that with a set of these pickers they increase their capacity from twenty to fifty per cent. The inventor is A. A. Ross of Oklahoma City, a practical cotton picker himself. With the labor shortage this picker is bound to prove popular throughout the cotton States. In addition to increasing the capacity of the worker, it also prevents pricking of fingers on cotton burs, a frequent and trying accompaniment of cotton-picking under the usual procedure.

## Throwing a Switch with the Foot

THE new San Diego and Arizona Railway has installed some foot-operated switches that make the life of the brakeman much easier and at the same time prevent a switch from throwing itself in the jar of a long freight train's passing over the rail intersection. When the arm operating the switch is thrown, it falls under a spring catch, from which it cannot emerge until the catch is opened by the foot lever seen in the picture. It is thus additionally safe and at the same time the brakeman finds it much easier and speedier than when he must put a pin in place after throwing the switch to hold the switch from jumping open.—By *Frank B. Howe.*

The foot-operated switch that can't be jarred open

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THE *practical* advantages of steel sash —its greater strength, longer life, and easier operation—are familiar facts.

But Lupton Pivoted Factory Sash lends itself equally to *beauty of design*.

Notice in the view below of the Crown Overall Manufacturing Co.'s building how the broad window openings—scarcely broken by the thin lines of the sash and mullions—emphasize the vivid white pilasters. Notice the balanced effect of the upper and lower ventilators in each window opening, and the harmony of proportion between the sash in the walls and in the corner towers.

Yet these upper and lower ventilators are not meant merely for looks; their real purpose is to give a balanced in-and-out air movement when there is no wind.

In a wide building like this, where many workers are likely to be crowded together, upper and lower ventilating openings are as essential to health as high ceilings and large glass areas are to easy vision.

We have published a 48-page booklet entitled "Air, Light and Efficiency," showing numerous sash applications to general manufacturing buildings. Some of them are very unusual. A copy will be sent free on your request.

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# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.*

## Pertaining to Apparel

DRESS SHIELD.—HELEN WEEKS, 216 W. 140th St., New York, N. Y. The object of the invention is to provide means whereby a dress shield may be quickly, conveniently and securely attached to the dress without resorting to sewing or to the use of safety pins. Another object is to permit of readily attaching or detaching the shield without its being visible through the garment or without requiring alterations thereof.

## Of General Interest

OPENER FOR GLASS TOPPED JARS.—D. C. RELYEA, Coscob, Conn. This invention relates to kitchen utensils and has particular reference to manually-operated means for opening glass-topped fruit jars, which are usually held sealed by external atmospheric pressure. Among the objects is to provide an implement which will serve two conditions, first the admission of air into the container for relieving the external pressure, and secondly a device which is least likely to cause the cracking, chipping or breaking of either the glass top or the rim.

WINDOW ATTACHMENT.—J. E. GALBRAITH, 20 W. 14th St., Whitestone, L. I., N. Y. This invention relates to an attachment more especially designed to cover the opening between the top rail of the lower sash and the upper sash to prevent insects, dust, snow, etc., from entering the room by way of the opening. Among the objects is to render the attachment serviceable in case the lower sash is raised to insert a screen in the lower portion of the window casing. The device may be adjusted to windows of different widths.

GATE CLOSER AND SUPPORTER.—R. P. BELLICAN, Natchez, Miss. An object of the invention is to construct a device which will act as a supporter and closer for closures, and more particularly gates, by means of which the gate will always be properly closed, the closer also acting as a supporter for the gate as well as a hinge, thus tending to control the life of the closure and to eliminate adjustments and repairs to a minimum.

SOAP CONTAINER.—E. O'CONNOR, 166 Market St., Newark, N. J. This invention relates particularly to soap containers adapted to form a part of a douche or internal bath device, which compels the water to pass through the soap to render the water soapy and supply such soapy water in such quantity as may be desired.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The object of the invention is to provide an alloy characterized by having a high acid-resisting quality, and increased density, an exceedingly close and fine grain, great tensile strength, increased elasticity, and electrical resistance. The alloy is formed of copper 50-60 per cent, nickel 26-34 per cent, iron 4-8 per cent, zinc, 7-11 per cent, and a deoxidizing or purifying agent, 25 to 5 per cent.

BED.—R. F. HELLWEG, 3660 Douglas St., El Paso, Texas. This invention relates to improvement in beds, an object being to provide coupling means between the side rails of the bed and the head of the bed which will permit the rails to be located either in position to support a spring or to support slats and to facilitate this double function, the side rails are of the ordinary angle iron form.

CHECK BOOK ATTACHMENT.—W. E. ABBOTT, Bend, Ore. An object of the invention is to provide a folding check book with a check clamp slidably engaging the checks and movable to a position across the field of the check so as to hold the checks smoothly while drawing the same, and which can also be moved into alinement with the division line between the check and stub, and operate as a straight edge against which the check can be torn.

SALT AND PEPPER BOX.—W. R. ELLIOT, Fairfield, Conn. This invention relates to salt and pepper boxes, having for its object a construction wherein separate salt and pepper receptacles may be supported by a single holder and controlled by a single cover so that only one box will discharge at a time. The two boxes are substantially duplicates with coacting means for holding a single movable cover in place adapted to stop the flow from either box.

GUN SIGHT.—E. E. GREGORY, Lewisport, Ky. The invention has for its object to provide a sight adapted for any form of gun, and so arranged that by using the sight with both eyes open the range will be automatically found. Two images of sight are formed when the marksman looking along the top of the gun barrel focuses his eyes on the target. These images appear transparent and in overlapping form an opaque central pyramidal image, the apex of which determines the point which should rest upon the target when the trigger is pulled.

BELL.—A. ROY, Hill City, So. Dak. The object of the invention is to provide a bell adapted to be attached to keys, as for instance, the keys of hotel rooms, for indicating with an audible alarm when the key is tampered with, by attempting to turn it from the outside, and which will also sound while the key is in the pocket through the movement of the carrier, thus preventing its loss.

BASKET.—G. L. O'DELL, 323 W. May St., Belding, Mich. The invention relates more particularly to an unwoven and unbraided, splint basket, although in all its phases it is not limited to baskets of that particular character. The general object is to provide a basket to be produced cheaper than braided baskets, and one which will give a better service.

DRIER TRAY.—C. E. JOHNSON, Boundbrook, N. J. The invention relates more particularly to trays used for the quick drying of dyes, paints, colors, chemicals, etc. An object is to provide a tray made of one sheet of metal bent into a shape such that a maximum drying surface will be exposed to the material to be dried and provide a plurality of passages which allow a free circulation of heated air.

DRINKING CUP HOLDER FOR WATER BOTTLES.—C. ROSENTHAL, 19 E. 9th St., New York, N. Y. The invention relates particularly to a device adapted to clamp upon the inverted upper end of a water bottle when the latter is in position in a water cooler, an object being to provide a device which will effectually support a carton or box containing a column of drinking cups in convenient position for use.

GROUND ANCHOR.—I. SOLBERG, 125 W. Stout St., Rice Lake, Wis. An object of the invention is to provide an anchor which will take a firm hold in the ground and which may be utilized for drawing an automobile out of a dangerous position, and which, of course, may be utilized for any other purpose wherever a rigid support is desired. A further object is to provide a ground anchor, which, when not desired for use, can be assembled and occupy but relatively small space.

WICKER PANEL.—W. H. STOCKER, 721 Lombard St., Philadelphia, Pa. The invention relates to panels of ratan, reed, willow or like material, and is adapted to be variously employed in the construction of furniture such as tables or chairs, or in building up walls or portions of walls. The general object is to provide a panel embodying frame elements and woven areas which will be strong and durable and will possess esthetic attributes to a high degree.

DRIP CATCHER FOR REFRIGERATORS.—A. B. BATES, c/o Genl. Deliv., Balboa Heights, Panama Canal Zone. The invention relates particularly to drip catchers for refrigerators, the object being the provision of a porous material arranged for catching the drip, which will obviate the removing and emptying of pans now commonly used for the purpose, the construction of the catcher effecting an evaporation of the waste water and in this way avoids the necessity of its removal.


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## The Problems of Electrification

*(Continued from page 444)*

ative costs show great economies. Another electrified western line is handling trains of 4,600 tons at a speed 20 per cent higher than was possible with steam traction and a limiting load of 3,500 tons.

Here in the East, down in a mountainous part of West Virginia where there is an extensive movement of coal from local mines, a railway formerly operated entirely by steam, now handles double the capacity on a certain section with 12 electric locomotives where it used to employ 33 great Mallet engines. The grades are extremely heavy, and yet, on the stiffest of these, trains of 3,500 tons are dealt with without trouble, and are moved about 100 per cent faster than when steam locomotives did the work. In fact, in numerous instances throughout the country, it is no uncommon thing to maintain electrified freight speeds of 15 miles or more an hour where formerly steam traction was limited to 6 and 8 miles. Thus we see how entirely feasible it is not only to reduce the bottle-necking condition but, at the same time to increase the loads which can be hauled by a single engine.

As is pretty generally known, several different systems of railroad electrification have been developed, each with its own particular claims to consideration. For the most part the lines so operated are not interrelated, and each typifies a more or less distinct step forward in the art; and as may be imagined each has its advocates. At present three lines focusing in the City of New York are using direct current of 600 volts, distributed by third rail. In effect this is an expansion of trolley practice to the main-line field—the third rail providing a conductor of sufficient volume to handle the heavy low-voltage current. Aside from complicating yard lay-outs and inviting numerous troubles, this arrangement is not suitable for long distances.

For trunk-line work, where the runs are of considerable length, we have naturally had recourse to trolley wires and high-voltage current in the distributive systems, and we have resorted to both direct current as well as single-phase alternating current on the roads concerned. The direct-current service has successively jumped from 1,500 volts to 2,400 volts, and then to 3,000 volts on the greatest electrified stretch in the country. But in order to obtain efficient primary distribution of energy from the power stations, alternating current of 100,000 volts is depended upon. This feeds to seven or more sub-stations along the route, where the alternating current is transformed to direct current of 3,000 volts by means of motor-generator sets installed at these points. As may be imagined, these sub-stations are necessarily complicated and extensive in their equipment.

Single-phase alternating current systems are in service in connection with a number of important roads in the East, where they are handling the varying demands of express and local passenger traffic and dealing efficiently with fast and slow freight on both fairly level and mountainous runs. Instead of motor-generator sets, as in the case of direct-current sub-stations, the transforming work is done by static transformers with no moving parts.

Similarly, where the overhead wires carry a much higher voltage than is needed for the operative motors of the electric locomotive or the multiple-unit train, small static transformers on either the locomotive or the cars meet every requirement. Structurally, they are of extreme simplicity, and besides are automatic in their functioning. High-voltage alternating current can be distributed farther, more efficiently, and by smaller conductors than is practicable in the case of direct current.

For multiple-unit operation, which must inevitably be counted upon to handle local passenger traffic in and out of populous centers, alternating current is preëminent-

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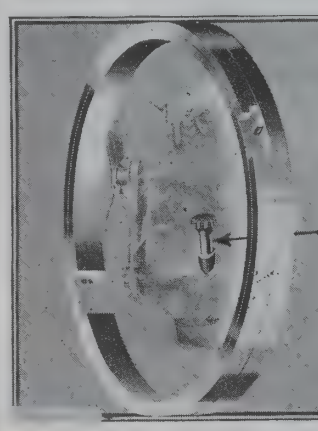

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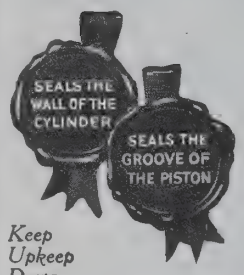


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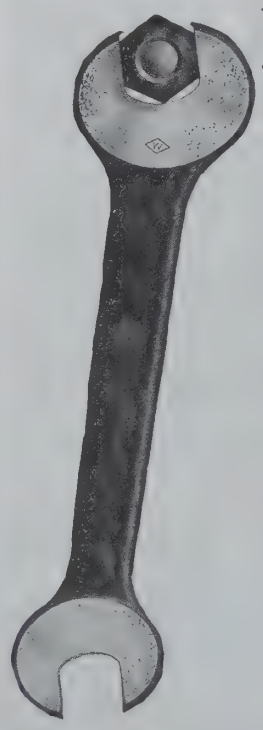

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ly suited; for it makes it feasible to equip every car with its own drive. The multiple-unit train, where every car or every other car is self-impelled, exerts a much augmented tractive effort, so that it can reach full speed in a brief while after a stop. Where high-voltage, direct current is used, on the other hand, the locomotive is relied upon generally to do all of the pulling, and only its driving wheels are tractors. Accordingly, it takes longer to acquire or to resume maximum headway, and the condition of the tracks may interfere with this to such an extent as to impose the hauling of fewer cars.

On mountain sections, where high-voltage alternating-current distribution is provided, and the locomotives are driven by induction motors, the problem of handling heavy freight trains is radically modified for the better because of the uniform pace and good speed which these tractors can maintain both up and down grade. Further, this type of tractor places a minimum burden on the brake installation.

In densely settled areas, railway electrification has occasioned two reflex vexations. Alternating-current systems give rise to a phenomenon known as inductive interference, which is apt to upset the operation of nearby telegraph and telephone lines. This annoyance has been pretty effectually reduced by the proper bonding of the rails so that the return circuit is taken care of in a way to obviate the disturbance of neighboring systems of communication. Inductive interference, like a mischievous boy, promptly betrays its activities in an audible manner. Direct current, however, promotes the electrolysis of underground conduits, etc.; and the extent of its silent, insidious and destructive work is very frequently not detectable until collapse of the pipes, structure, etc., takes place. Then the damage may be of a very costly nature.

It is probable that no one system will be accepted to the exclusion of all others, but when a system is selected for a given railroad the decision should be made only after careful consideration not alone of the problems of that particular line but also of those of its neighbors—in this way achieving as complete a measure of unification as is economically possible.

## California's Seaweed Industry

(*Continued from page 445*)

The process of manufacture is ingenious and interesting in view of the fact that they designed all the machinery and equipment for a purpose entirely new. The whole takes seventy-two hours but operation necessarily is continuous. The leaves and stems of the algæ are used. One of the most clever conceptions in the factory is a battery of four "mortars" or bowls twenty-two inches in diameter and fourteen deep in a solid block of concrete, with corresponding quadruple wooden "pestles"—an adaptation on a modern mechanical scale of the primitive method of grinding. Into these mortars the raw material or dry weed is first placed and in a few minutes it is stamped into a fine mass. The object is to free it of the millions of tiny shells, bits of sand, alkaline deposits and other foreign matter. Then it goes through various tanks and vats, one containing a secret solution for bleaching and the others plain water for washing, after which it is run through a wringer and spread on racks to dry in the California sun. It looks like white moss.

Next it is boiled three to four hours, filtered, distributed in galvanized iron trays four feet long, two wide and three inches deep, and five hours later it comes out jelled, like a large sheet of rubber. In this form it comes to the sharp knives of another wonderful machine, which cuts it into pieces a foot long and two inches square, each intact but sliced lengthwise as are noodles. Having now undergone extreme heat a siege of the opposite character is provided, for it is placed on wooden trays and carried into a great refrigerating room and for ten hours kept at ten degrees below zero. The sticks come out solid ice. They are slowly melted, the water drained off, then put through a forcing machine which flattens each "noodle" into a thin, transparent sheet. Again the California sun is invoked to dry them. Finally they are tied in three-pound sheaves of silvery sheen, and thus they first go into the market.

The factory is also making a superior vegetable isinglass as an experiment and the owner believes he can approach in quality, at low cost, the Russian mineral isinglass now selling for $11.50 a pound. An adhesive plaster, photographic films and other products are included in his plans, which thus far have in nowise been disappointing. Potash, iodine and other by-products of the algæ will be conserved, appliances for that purpose being in course of installation.

## Edison's Views on Life and Death

(*Continued from page 446*)

lions upon millions of entities, and that our body and our mind represent the vote or the voice, whichever you wish to call it, of our entities.

"Now let's see why we must be composed of life entities. Supposing you take a finger print of your thumb, in the conventional manner of the police records. Then burn your thumb sufficiently to destroy the skin. Do you know that after the new skin has formed the finger print of your recovered thumb will be precisely the same as the first one? Yes, absolutely the same, even down to the last line and irregularity. I tried it to make sure. Here is a mystery which has remained unanswered until now.

"Of course, you say it is nature. But what is nature? That seems to me to be such an evasive reply. It means nothing. It is just a subterfuge—a convenient way of shutting off further questioning by merely giving an empty word for an answer. I have never been satisfied with that word 'nature.' Now my answer is that the skin didn't happen to grow that way again by accident. Someone had to plan the new growth and to supervise it to make certain that it would conform in every way with the old skin. You do not know just what that pattern is, and so your brain plays no part in the operation.

"Here is where our life entities come into action. I firmly believe that the life entities rebuild that thumb with consummate care, drawing upon their remarkable memory for all the details.

"Let us consider an analogy, for the sake of making my point more clear to you. Supposing that a man from Mars came to this earth, and his eyes were so much coarser than ours that the smallest thing he could see was the Brooklyn Bridge. He could not see us. Naturally, he might take Brooklyn Bridge for some natural growth, just as we consider grass, sand, minerals and other things as matters of natural development. Supposing that same man from Mars were to destroy the Brooklyn Bridge, and several years later he happened to find a new bridge in precisely the same place and of precisely the same design. Would it seem logical for that man to assume that the bridge simply grew again in the same manner and in the same place? Don't you suppose that the Martian would be compelled to assume that some intelligence and guided effort were behind the rebuilding of the structure he had destroyed?

"That is precisely the stand we should take regarding the life entities. Obviously, the entire matter is one of conjecture. Perhaps the entities in our bodies are ninety-five per cent workers and five per cent directors. At any rate, it is the ensemble of all these entities which gives us our physical form, mental properties, personality, and so on.

"The entities are life, I again repeat.

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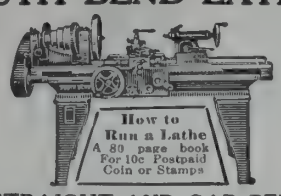


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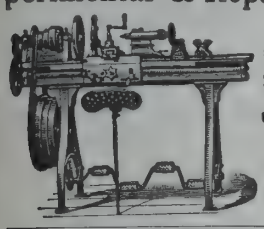

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They are steady workers. In our bodies these entities constantly rebuild our tissues to replace those which are constantly wearing out. They watch after the functions of the various organs, just as the engineers in a power house see that the machinery is kept in perfect order. Once conditions become unsatisfactory in the body, either through a fatal sickness, fatal accident or old age, the entities simply depart from the body and leave little more than an empty structure behind. Being indefatigable workers, they naturally seek something else to do. They either enter into the body of another man, or even start work on some other form of life. At any rate, there is a fixed number of these entities, and it is the same entities that have served over and over again for everything in this universe of ours, although the various combinations of entities have given us an erroneous impression of new life and still new life for each generation.

"The entities live forever. You cannot destroy them, just the same as you cannot destroy matter. You can change the form of matter; but of gold, iron, sulfur, oxygen and so on, there was the same quantity in existence in the beginning of this world as there is today. We are simply working the same supply over and over again. True, we change the combinations of these elements, but we have not changed the relative quantities of each of the elements with which we started. So with the life entities, we cannot destroy them. They are being used over and over again, in different forms, to be sure, but they are always the same entities.

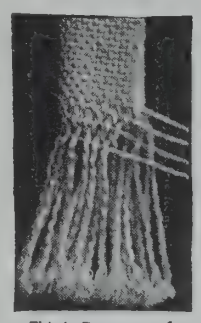
"The entities are so diversified in their capabilities that it is difficult to identify their handiwork in all instances. Thus today the scientists admit the difficulty of drawing a line of demarcation indicating where life ends and inanimate things begin. It may be that life entities even extend their work to minerals and chemicals. For what is it that causes certain solutions to form crystals of a very definite and intricate pattern? Nature! But what is nature? Is it not fair to even suspect that life entities may be at work building those crystals? They don't simply happen. Something must cause certain solutions always to form certain kinds of crystals.

"Now we come to the matter of personality. The reason why you are Lescarboura and I am Edison is because we have different swarms or groups or whatever you wish to call them, of entities. After eighty-two remarkable surgical operations the medical world has conclusively proved that the seat of our personality is in that part of the brain known as the fold of Broca. Now it is reasonable to suppose that the directing entities are located in that part of our bodies. These entities, as a closely-knit ensemble, give us our mental impressions and our personality.

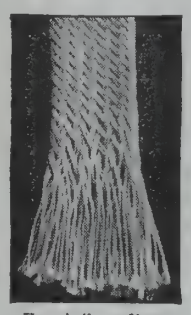
"I have already said that what we call death is simply the departure of the entities from our body. The whole question to my way of thinking, is what happens to the master entities—those located in the fold of Broca. It is fair to assume that the other entities, those which have been doing purely routine work in our body, disband and go off in various directions, seeking new work to do. But how about those which have been directing things in our body—those which are Lescarboura, Edison, Meadowcroft and so on? Do they remain together as an ensemble or do they also break up and go about the universe seeking new tasks as individuals and not as a collective body? If they break up and set out as individual entities, then I very much fear that our personality does not survive. While the life entities live forever, thus giving us the eternal life which many of us hope for, this means little to you and me if, when we come to that stage known as death, our personality simply breaks up into separate units which soon combine with others to form new structures.

"I do hope that our personality survives.

# Duracord on portable coal conveyors



*This is Duracord. Thick, heavy strands, woven like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.*



*Here is the ordinary braided cable covering. Note the open and porous construction, easily cut, stretched or unraveled. Compare it with the illustration of Duracord above.*

PICTURE the wear it gets. Dragged around the yard, run over by heavy wagons, walked on, buried under falling coal—Duracord defies it all.

This sturdy portable electric cord is made for just such service. It has a big thick *woven* fabric covering that accepts its full responsibility and never lays down on the job. It outwears ordinary cord many times.

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In addition to portable conveyors, Duracord is used on magnetic cranes, mining machinery, locomotive headlights, cement mixing machines, welders, portable electric tools, extension lamps—wherever the ability to stand hard knocks is an asset.

Duracord is made in all sizes of portable electric cord and the larger sizes of single and duplex cable. Ask your electrical jobber or let us send you samples of Duracord and ordinary cord for you to test and compare yourself.

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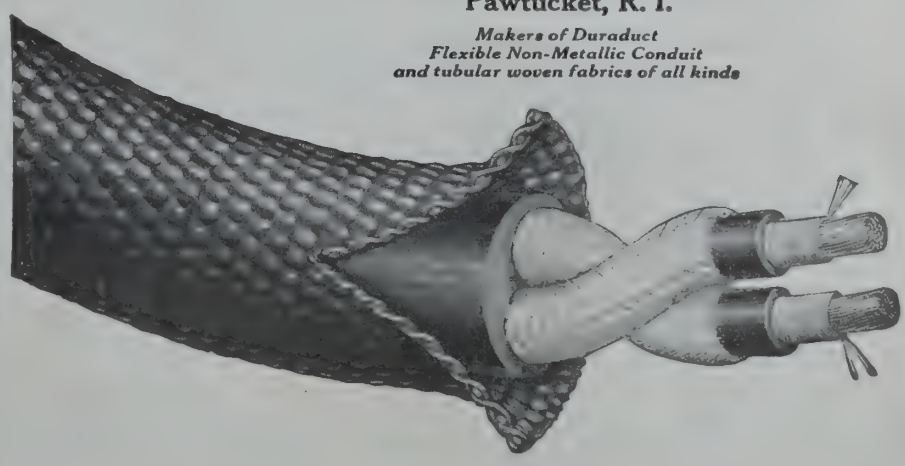
*Flexible Non-Metallic Conduit*
*and tubular woven fabrics of all kinds*



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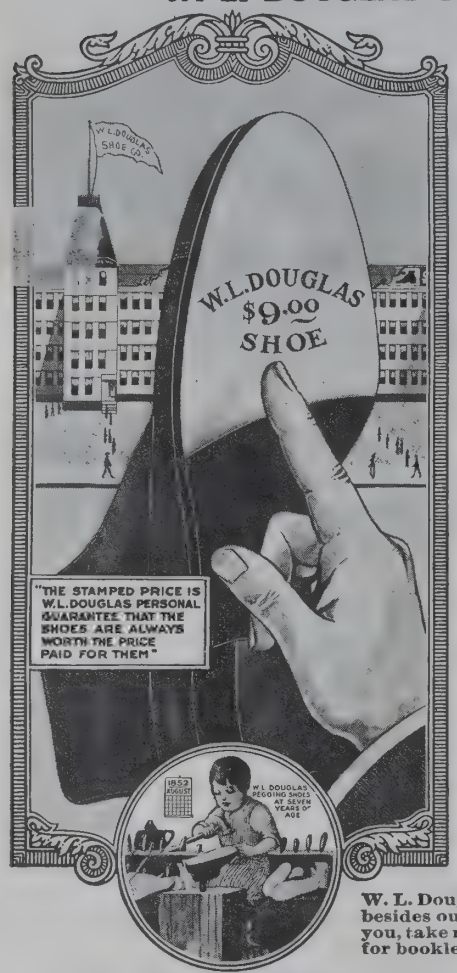

The best known shoes in the world. They are sold in 107 W. L. Douglas stores, direct from the factory to you at only one profit, which guarantees to you the best shoes that can be produced, at the lowest possible cost. W. L. Douglas name and the retail price are stamped on the bottom of all shoes before they leave the factory, which is your protection against unreasonable profits.

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W. L. Douglas shoes are made by the highest paid, skilled shoemakers, under the direction and supervision of experienced men, all working with an honest determination to make the best shoes for the price that money can buy.

W. L. Douglas shoes are for sale by over 9000 shoe dealers besides our own stores. If your local dealer cannot supply you, take no other make. Order direct from factory. Send for booklet telling how to order shoes by mail, postage free.

CAUTION.—Insist upon having W.L.Douglas shoes. The name and price is plainly stamped on the sole. Be careful to see that it has not been changed or mutilated.

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If it does, then my apparatus ought to be of some use. That is why I am now at work on the most sensitive apparatus I have ever undertaken to build, and I await the results with the keenest interest."

## Getting a Line on Concrete Pipe

(*Continued from page 449*)

type of the finished product can be compared with other joints of pipe made of specially prepared mixtures, the comparison reflecting the character of materials, proportions, water content and other ingredients.

Permeability tests are conducted upon the completion of the tensile-strength investigation, the same specimens being used. A concrete block, one side of which conforms to the inside surface of the specimen, constitutes the testing apparatus. It is held against the surface by two clamps. Water is furnished through a one-fourth-inch iron pipe running through the tester to the surface to be tested. Escape of water is barred by an inflated gasket seated in a groove around the edge of the tester. Fifty pounds of water pressure is applied for one-half hour. The quantity of sweat or seepage is noted at 5-minute intervals. Specimens are air-cured 29 hours and water-cured 3 weeks. Absorption tests are made on the same specimens. These are dried out in an electric oven to constant weight and then immersed in water. Weights are taken at one-half hour, 4 hours and 48 hours. The percentage of absorption is based on dry weight.

Definite results, although not comprehensive because of the incompleteness of the investigation, are available from the experiments. An outstanding conclusion is that proper grading of select material is the most essential factor in the manufacture of an excellent quality of concrete pipe. The porosity of a pipe is influenced largely by the grading of the material. Rock dust up to 10 per cent and clay free from organic matter up to 5 per cent have proven their efficacy in preventing seepage without decreasing the strength of the pipe.

Laboratory tests show that a substantially large variation in water content does not materially influence the strength of the pipe, conditional upon the mixture being heavily tamped. Under light tamping, pipe made of a so-termed "dry mixture" is much weaker and seeps freely. A first-rate quality of broken rock of uniform toughness insures the strongest pipe. This may be attributable to the difficulty of finding gravel free from soft or disintegrated particles in California. The breaking strength of concrete pipe under water pressures varies widely, the variation being due to the manner of testing. If a pipe is thoroughly saturated several days before the test is made a good quality of pipe will test as high as when dry, while a poor quality shows a decrease in strength of from 20 to 60 per cent.

That concrete expands and contracts when influenced by changes in temperature, is knowledge of general acceptance. However, the information that a concrete pipe expands when changed from a dry to a wet condition and contracts to a like extent when the conditions are reversed is not such common knowledge. A concrete pipe, when subjected to water pressure for some time, if permitted to dry, may contract as much as it would under a drop of temperature of 100 degrees Fahrenheit. Excessive internal stresses in concrete pipe, not infrequently resulting in ruptures, are created by having the lower part of a pipe line wet if not saturated and the upper part dry. Seepage through the shell of a pipe under water pressure will appear under low pressures nearly as rapidly as under high pressures. If water is going to percolate through a pipe, a pressure of 5 pounds to the square inch will indicate with reliable accuracy the quantity of water likely to pass through the shell.

## Hardening Steel in Gas-Fired Furnaces

(*Continued from page 450*)

of quenching is not quite so rapid, or as severe as water or brine, yet quick enough to give the proper hardness to most all work.

It is important to keep all quenching baths cool, and replenished from time to time with a fresh supply of the liquid. Where water is used it is best to keep up a fresh supply continuously. Oil baths are cooled either by a series of cold water pipes around the tank, an agitation of the oil by compressed air, or a circulation of the oil. The last-named method is perhaps the best as it not only causes a cooling o fthe oil but also a constant changing of the bath and takes the heated oil away from the metal after it gives up its heat to the oil.

Quenching should be done rapidly but uniformly. Tongs for holding the work should have as small grip as possible. Long pieces of steel, including drills and reamers should be quenched with their axis vertical. Where this is impossible such as in very long round rods, they should be made to roll into the quenching bath with their long axis horizontal, but they should enter the bath very quickly. Round cutting tools should be immersed with their axis horizontal. Small tools or pieces should be kept in motion when placed in the cooling bath.

Warping occurs frequently in hardening steel pieces and may be attributed to one of two causes—uneven heating or quenching too long. Some pieces should be left in only long enough to harden extreme edges. Again it is often necessary to immerse the piece at an angle in order to overcome this difficulty. Therefore, it will be necessary to give considerable thought to the shape and design of the tool, in order to obtain the best results.

## The Heavens in November, 1920

(*Continued from page 452*)

Jupiter is a morning star, rising at 1 A. M. in the middle of the month. Saturn is about seven degrees farther east, and rises half an hour later. The two planets are on the borders of Leo and Virgo, and afford a fine spectacle in the morning sky. Uranus is in Aquarius, observable in the evening, and Neptune is almost opposite in the sky, and visible before daybreak.

The moon is in her last quarter at 3 A. M. on the 3rd, new at 11 A. M. on the 10th, in her first quarter at 3 P. M. on the 18th, and full at 9 P. M. on the 25th. She is nearest the earth on the 27th, and farthest off on the 15th. During the month she passes near Neptune on the 3rd, Jupiter on the 5th, Saturn on the 6th, Mercury on the 11th, Venus on the 13th, Mars on the 15th, Uranus on the 18th, and Neptune again on the 30th.

On the morning of the 10th there occurs a partial eclipse of the sun, which is visible throughout the northern and eastern portions of the United States, and as far west as Kansas. The eclipse begins about 9 A. M. eastern time and lasts more than two hours for observers in New England and the Middle States, about one-third of the sun's diameter being obscured on the northern side. The magnitude of the eclipse will be smaller, and the duration shorter for observers farther south and west, till it fades away to nothing in Alabama and Arkansas.

## Do Moths Use "Wireless"?

IT has for long been known that certain species of moths are able to communicate with one another even though separated by a considerable distance. This fact is to be noticed very plainly during the pairing season. A female of the Vapourer Moth (Orayia) may be enclosed in a wooden pill box. She will then attract males from all directions, and these will come from a distance of a mile or two.

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# SCIENTIFIC AMERICAN

NOV 6 1920

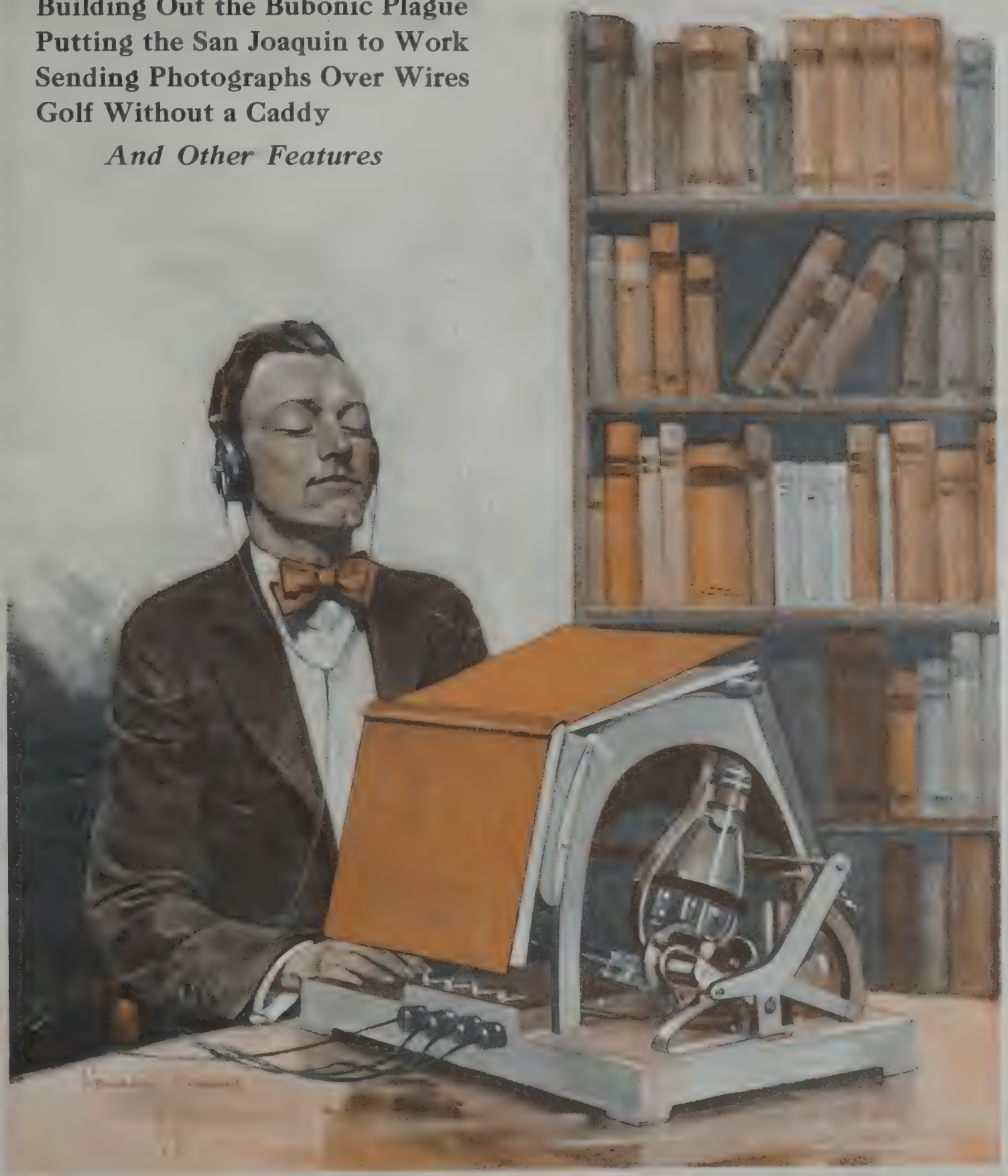
*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

*IN THIS ISSUE:*

**Building Out the Bubonic Plague**
**Putting the San Joaquin to Work**
**Sending Photographs Over Wires**
**Golf Without a Caddy**

*And Other Features*



HOW THE BLIND MAY READ ALL BOOKS BY MEANS OF THE OPTOPHONE.—[See page 463]

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Davis is another motor car builder who has built success and reputation on proved units, each the product of a specialist in its particular line. In following out this policy the importance of the part played by front and rear axles—the support and final drive—was fully realized.

Timken-Detroit Axles, the result of twenty years of striving to build still better axles, will be found under the Davis, as well as under thirty-two other sturdy leaders in the American passenger car field.

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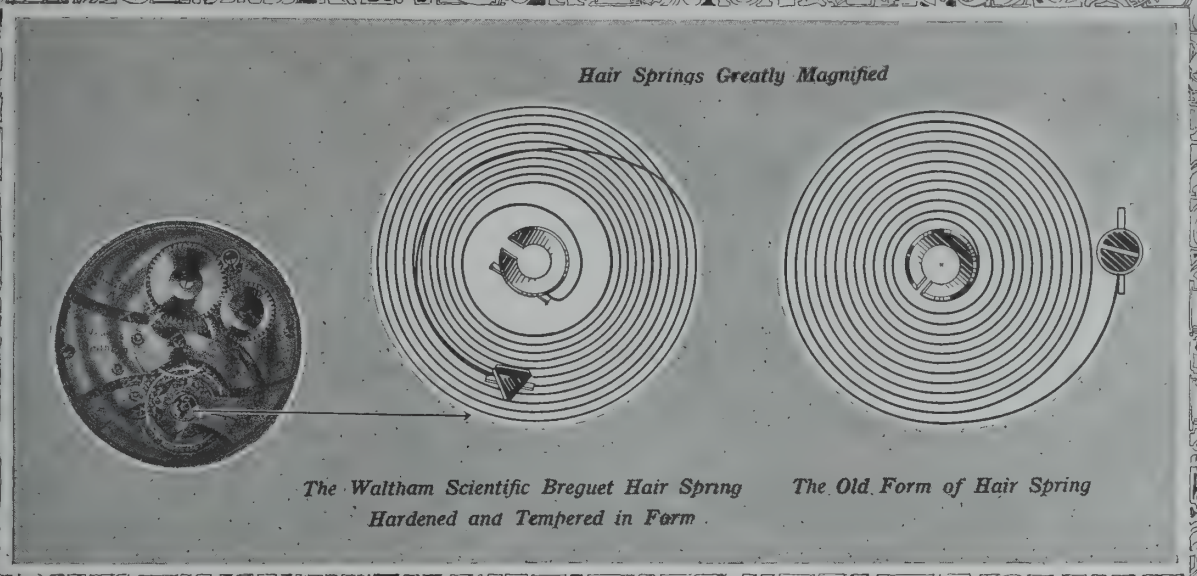


THE MOST SCIENTIFICALLY BUILT WATCH IN THE WORLD

## The Waltham Scientific and Exclusive Process of Hardening and Tempering the Hair Spring in Form

THE Hair Spring is to the balance wheel of a watch what gravity is to the pendulum of a clock.

The Hair Spring is so extremely important in its mechanical functions that we affirm — a watch is only as good as its hair spring.

Therefore, the Hair Spring that most closely approximates perfection in the watch you buy gives you more value for your money as a time-keeper and as an appreciated investment.

*The Waltham Hair Spring is the only Breguet Hair Spring in the world that is hardened and tempered in form.*

In other words, the end of the unscientific hair spring is twisted into the Breguet shape *after* the spring is hardened and tempered.

Therefore, if this unscientific hair spring happened to be of *fine* steel temper, it would have to function under undue stresses.

What does this imply? That, sooner or later, the resiliency of such a spring *must* deteriorate, making the watch an erratic time-piece.

The genius of Waltham overcame this unknown factor of irregularity in the Hair Spring by inventing and patenting a process whereby the whole hair spring was shaped to its ultimate use *and kept in that perfect shape* while being hardened and tempered.

The over-coil called Breguet (after the name of its inventor) was a great invention of years ago, but it affected only the outer half of the spring. And, because of the Waltham scientific method of hardening and tempering in form, it became possible for Waltham to perfect and add an inner terminal bend which gives equal action to both ends of the spring.

*This is a vital and exclusive Waltham invention.*

It gives to a Waltham Watch a greater dependability and a closer precision. It has made the Waltham Watch the most sought after watch in the world. It gives to the buyer of a Waltham Watch a confidence that herein is the art of watchmaking at its highest development.

Last, but not least — the Waltham Scientific Hair Spring hardened and tempered in form is an *American invention,* exclusively Waltham —

An unanswerable argument why your watch selection should be a Waltham.

**Waltham 7½ Ligne**

The movement is actually smaller than a dime in diameter

$250 to $1,500 or more depending upon the case

*This story is continued in a beautiful booklet in which you will find a liberal watch education. Sent free upon request. Waltham Watch Company, Waltham, Mass.*

# WALTHAM

## THE WORLD'S WATCH OVER TIME


The Scientific American, November 6, 1920. Volume 123, Number 19. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year
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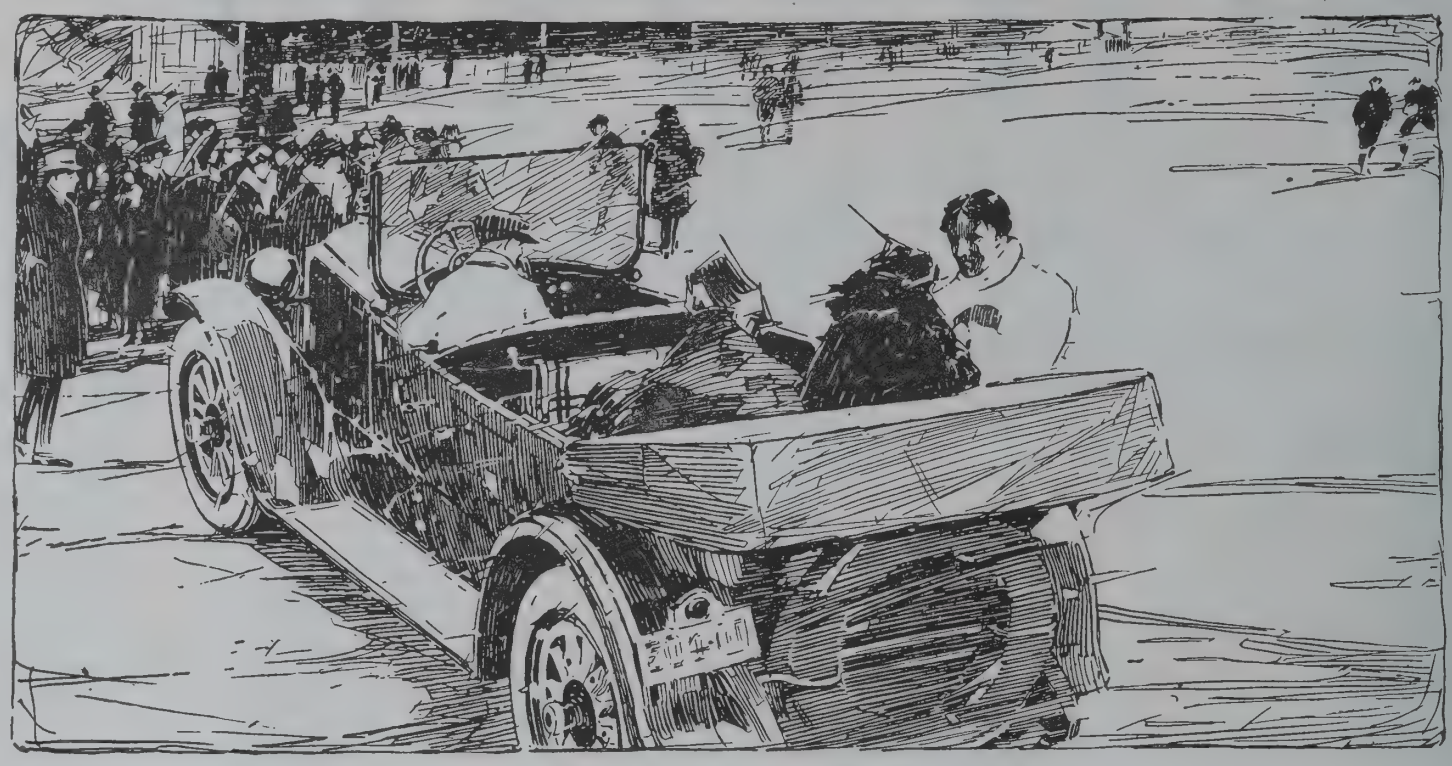

# You never know what a car can do until you get a PACKARD

AFTER all, the chief difference between the Packard and some other car is very easily stated.

It is the difference between giving the owner *everything he can make use of*—or building down to the least he can ask of his car.

If there were any compromise anywhere in the Packard Car; any attempt to build down to a competitive price basis; any feeling in the Packard organization that the American public can be influenced by pose or "side" or talk of "What they do in Europe"—the Packard could not be the *practical car* it is.

There are a number of cars with high power ratings.

Yet you see the Packard running all around them.

It is the same way on the hills as on the level road; and the first car to shoot out of the traffic jam is a Packard.

You will hunt far before you find a car of equal size that does its work on such a slight expenditure for gas and tires.

The thing that sets the Packard apart is its *forethought for all the use* a man can make of his car.

PACKARD MOTOR CAR COMPANY, *Detroit*

## TWIN SIX

is built to give the owner everything he can make use of – no compromise.

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 19 ] NEW YORK, NOVEMBER 6, 1920 [ 15 CENTS A COPY 20 CENTS IN CANADA

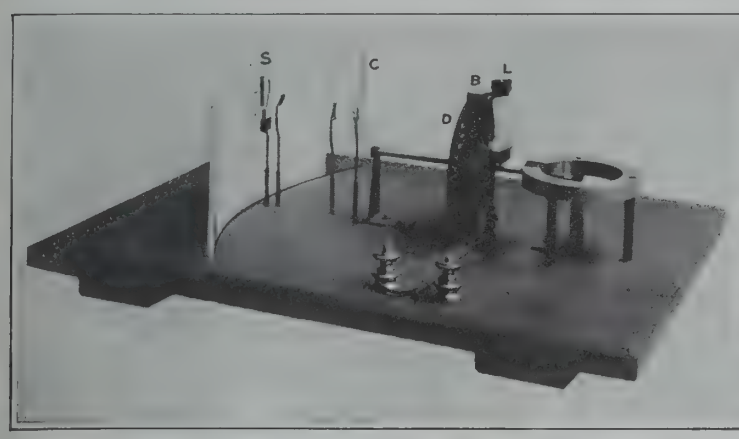


Fig. 1—Skeleton apparatus showing the principle of the "black-sounding" optophone

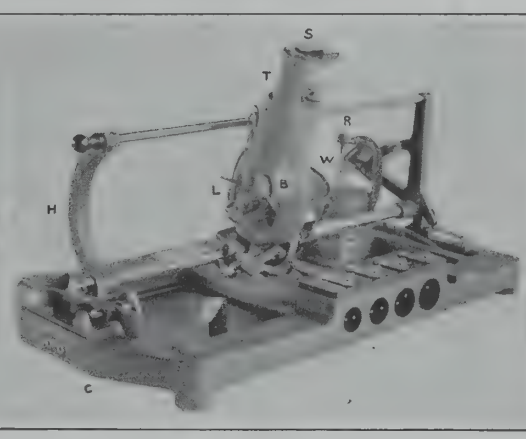


Fig. 2—The optophone with book rest removed, showing the "tracer" mechanism

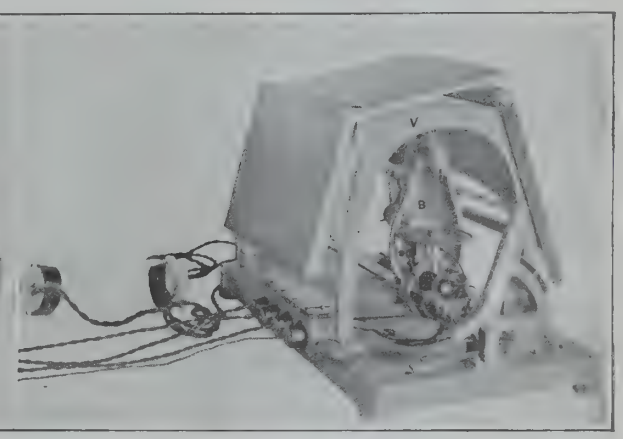


Fig. 3—The optophone complete with conventional book in place ready for reading

**Simple and standard forms of optophone which enable the blind man, after some practice, to read type matter by means of sound**

## The Type-Reading Optophone

### An Instrument Which Enables the Blind To Read Ordinary Type

IT would be difficult to conceive of a more remarkable electrical device than the type-reading optophone, which enables the blind to read ordinary type. This device, be it understood, is not altogether new as far as its basic principles are concerned. As far back as August 3rd, 1912, the SCIENTIFIC AMERICAN SUPPLEMENT carried a description of the first optophone which in its earliest form was an instrument for converting light into sound in such a manner that the blind were enabled to see by ear, so to speak.

The optophone was the invention of Dr. E. E. Fournier d'Albe of Birmingham University. Dr. d'Albe later developed a type-reading instrument by which the blind could read large print. Recently the instrument has been greatly improved in coöperation with Messrs. Barr and Stroud of Glasgow, the well-known instrument makers. In its present form it can be adjusted for any ordinary type, but it is well to direct attention to the fact that the blind person making use of the optophone must have a very fine musical ear in order to grasp the tone combinations emitted by the instrument and translate them into reading matter.

The general principle of the apparatus is shown in Fig. 1, wherein a siren disk, *D*, is run at about 30 revolutions a second by means of the small magneto-electric motor shown. It contains five circles of square perforations, the innermost circle having 24 perforations, the outermost 42, the other circles being intermediate and corresponding to the relative frequencies of certain notes of the diatonic scale. A line of light in a radial direction is provided by the straight-filament lamp *L*, and the image of the filament of this lamp is thrown upon the print by a system of three lenses on the other side of the selenium tablet *S*. The axis of the concavo-convex lens *C* is slightly tilted out of the axis of the other lenses for a purpose which is specified below. The general result of the optical system is to give a line of luminous dots on the print, each dot having a different musical frequency. The light constituting these dots is diffusely reflected back on to the selenium, which is put in circuit with a battery and a high-resistance telephone receiver. Those dots which fall on white paper produce a note of their own musical frequency in the telephone, while those which fall on black are extinguished, so to speak. We thus get what may be called a "white sounding" optophone, in which the black letters are read by the notes omitted from the scale rather than by the notes which remain sounding. All the reading demonstrations hitherto undertaken have been given with a "white-sounding" optophone, with the most satisfying results.

A modification of this principle, we learn from the SCIENTIFIC AMERICAN MONTHLY [successor to the SCIENTIFIC AMERICAN SUPPLEMENT] for October, has been introduced by Messrs. Barr and Stroud in consultation with Dr. d'Albe. This is the provision of a second selenium preparation in the form of a cylindrical rod, the top of which can be seen at *B*. This rod receives the light reflected by the concave surface of the lens *C*, which produces a real image of the line of dots on a generator of the cylindrical rod, and by turning this rod about its axis the image can be made more or less effective as desired. By balancing the effect on *B* against the effect on *S*, when white paper alone is exposed, a silence can be produced in the telephone, and the effect of the passage of a black letter is to make a sound which varies in accordance with the formation of the letter. This is the principle of what may be called a "black-sounding" optophone, and although its advantage over the "white-sounding" type has yet to be proved, there is little doubt that the learning of the alphabet sounded on the new principle will be easier.

The present construction adopted by Messrs. Barr and Stroud is shown in Fig. 2. Here the disk, lamp, lenses, and selenium, as well as the motor, are all mounted in the swinging "tracer," which can be brought over to the right by means of the reading-handle *H*. It then returns to the left with a slow, silent and steady motion regulated by the worm gearing *W*, which drives a small paddle inserted in a viscous liquid. This paddle can be inserted more or less deeply into the liquid by the regulating nut *R*, and such is the range of adjustment possible that a line can be read in anything from five seconds to five minutes, according to the proficiency of the reader. When the line is read, the next line is brought into focus by the change-bar *C*, which works a friction grip inside the bar on which the "tracer" is pivoted, and can be adjusted for any desired line space by means of the screw attached to the change bar. A lever attached to the "tracer" enables the operator to reverse this motion or to release the whole "tracer" from the friction gear, so that it may be quickly brought to the top of the page.

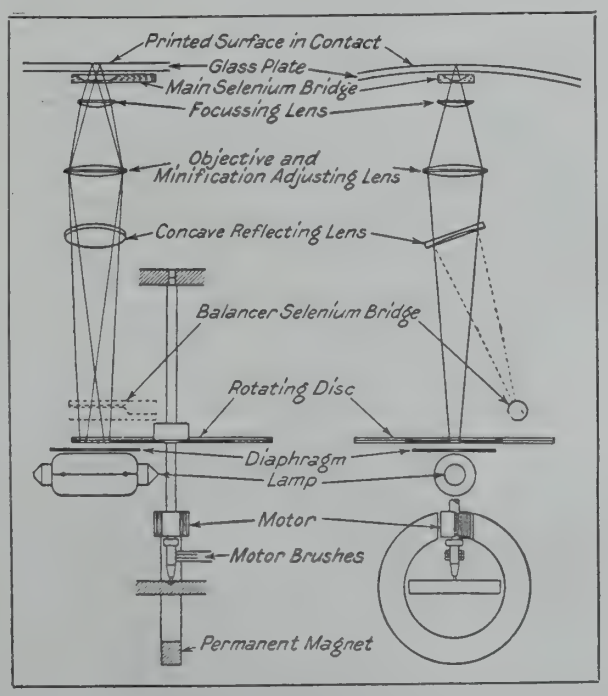


**Diagram of the arrangement of the optophone as seen from two sides**

The straight-filament lamp is inserted at *L*, where it is held by a spring clip, and whence it can easily be removed for renewal even by a blind operator. The balancer is inserted at *B*, and can be adjusted for silence by means of the small handle shown.

Fig. 3 shows the apparatus from the top page end and with telephone and flexible connections attached, as well as the book-rest *V* holding a book. The adapters of the flexible connections are all of different sizes and fit into different-sized holes in such a manner that they cannot be wrongly inserted.

The operator of the optophone reads by the tones and combinations of tones emitted by the telephone receiver. The numbers of perforations in the siren disk are in proportion to the notes G, C′, D′, E′, G′, (sol, do, re, me, sol) of the musical scale. The spot of light corresponding to low G falls on the lowest point of such letters as j, p, y, etc., the high G′ falling on the tops of capitals and high letters. The three intermediate spots cover the body of the lower case letters. With a "black-sounding" optophone the letter *V* is represented by the motif (high) sol, me, re, do, re, me, (high) sol.

In practice it is found that, with the new apparatus, the various adjustments for size of type, length of line, and line interval are quite easily made by blind persons, and that the instrument, with all its delicate adjustments, can remain in use for a long time without anything getting out of order. As for speed of reading, we are told that Miss Mary Maeson, the blind girl who has been giving demonstrations with the optophone for some time, now reads habitually at a speed of about 25 words a minute with a "white-sounding" optophone. But again we repeat, a so-called musical ear is a very necessary qualification.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Our Surplus, Our Ships, and Europe's Need

THANKS to our enormous industrial development during and even since the war, thanks also and even more to weather conditions extremely favorable to agriculture, the United States finds itself with a great surplus of products on its hands. Also, because of our enormous shipbuilding activities during the war and since, we find ourselves possessed of the second greatest merchant fleet in the world, with probably 70 per cent of it consisting of absolutely new shipping and most of it made up of cargo-carrying vessels.

On the other hand, if we turn from the thought of our own superabundance and let our gaze rest upon Europe, we find there a scarcity so great that the peoples of the old world, or at least of the western half of it, are looking with hungry eyes upon our unused and unusable superabundance. At present market values we have surplusses, available for export, of $800,000,000 in cotton, $600,000,000 in wheat, $250,000,000 in packing-house products, $750,000,000 in semi-manufactured raw materials and finished manufactured products of various kinds—all this according to E. M. Hurley.

There is no lack of ships. Anyone who has had occasion to traverse any of the great harbors of the Atlantic seaboard must have wondered why in the world such quantities of cargo ships flying the American flag are floating high and empty on the mooring grounds of these harbors. It certainly does seem pathetic or monstrous or wasteful or ridiculous, according to the point of view of the speaker, that so much suffering, unrest and threat to the social and economic structure should be allowed to persist, when the means to relieve it in the way of surplus products and surplus ships are right at hand.

If that overworked "Visitor from Mars" were to ask the why and wherefore of these amazing conditions, he would be told, as Mr. Hurley recently told the diners at a banquet of the National Marine League, that "while the countries of Europe are in the market for the major portion of our surplus, our marketers of wheat, cotton and other products still ask for payment in gold at our seaports before goods are shipped." In answer to his inevitable question as to why they do not pay in gold, we should have to explain to him that most of it is already in this country.

To the student of economics the explanation is perfectly clear. These suffering countries cannot pay us in gold for they have it not. It is out of the question for them further to inflate their currency by creating huge indebtedness, for they are already overloaded. The problem is not one to be solved by the assistance of the United States Treasury, for already we have loaned over ten billion dollars to Europe. It is the belief of Mr. Hurley and of an increasing number of our leading business men that the problem should be solved strictly on a commercial basis. With these enormous excess products to sell and with our natural overseas customers restricted in their purchasing power, we should coöperate to place them in a position to make their needed purchases. It should be possible for the marketers of these divers products themselves to work out coöperatively a system of credits; and it is suggested that the creation of a commercial bond issue of from one hundred million to one hundred and fifty million dollars would furnish a sufficient fund during the period of the marketing of these products. What is needed and needed at once is a relatively limited creation of additional private credit without invasion of government credit.

As to the security, the marketers of the various products would receive in return an obligation from the purchaser, definite as to amount and interest and time of payment. These would constitute the security. They would have the guarantee of the purchaser's particular Government, which, Mr. Hurley assures us, nearly all of the European Governments are willing to grant. It is possible also that the guarantee of the marketers in this country would be added. We do not doubt that this relatively small bond issue secured in the manner suggested would be quickly absorbed here. The benefit to Europe would be immediate and incalculable.

## Joys and Sorrows of the Einstein Editor

EVERYTHING has its lighter side. Even the Einstein Editor, on whom devolves the function of opening and recording the essays received in the contest and preparing the tentative abstracts of them for the use of the judges, reports that his cloud has a silver lining. We consider this the height of optimism; for at the hour of going to press there are 151 essays in, with five days still to run.

However, the unfortunate member of the staff most directly involved assures us that the bright spots are there. For one thing, he regrets the day when he rashly required the contestants to send their inner envelopes sealed. In Europe this means legally sealed and stamped with a splash of wax—or several splashes. It is, on this side, rather a novel experience to receive a bulky envelope bearing five ponderous red or black smears—one at the crossing of the flap in the middle and one off toward each corner; and on opening this, to discover in it two smaller envelopes, each similarly decked out. There has been enough wax used in this contest to float a dreadnought.

Another amusing item is the envelopes. Purely on the basis of mathematics, if 151 gentlemen are to select two small envelopes and a larger one to hold them, it would seem that some two of these 453 containers would necessarily be of the same size and shape. The Einstein Editor finds that performance gives the lie to theory; and he contemplates a dissertation in which the foundations of the theory of probability will be revised. It is impossible that the world contains so many different styles of envelope—impossible, but true.

A curious feature is that several contestants have selected subjects of their own—"Mastering Success," "Leagues of Nations in History," "The Situation of a Government Clerk in the Madras Presidency, India," etc. We are puzzled to know whether local papers have announced the contest without troubling to announce that the subject was prescribed; or whether these worthies have tried to display a Machiavellian cunning in writing on a subject of which the judges shall not be wearied.

Discounting the few trivial essays inevitable in such a contest, the general level of competition is gratifyingly high. It is interesting to note that German and French and Dutch authors show on the whole rather good command of the English language. One German essay, in particular, on being examined by our two editors who display greatest literary talent, provoked the admission that, with the same ideas to express, neither of these gentlemen would dare hope to clothe them in more elegant or more precise English. By way of contrast, there comes another effort which bears indisputable evidence of having been written first in German, and then, with the aid of a dictionary and a colossal ignorance of the English language, lifted over, word by word, into English. The author confides that he hopes to win the prize, but that failing this he has at least "learned some English." Just how much, appears from the following excerpts:

"Some 400 jears ago the earth was a side-ways unboundet mass, above the heaven and under the hell. By degrees but heavy one accustomed thereon, that under us also men live and thereto with the feet to above and they stand however fast on the earthground, when they with the finger to above show, so is that the same direction, as we under name. . . . So will go also a time, that all thereon accustom, that after Einstein we not a absolute and only a relative time have. . . . Think we us the world-room like a absolute reposing empty reservoir. . . . Einstein remove this hardiness. . . . Think we us a planet go tight to the earth over, our clocks have equal going time. . . . When now the time-measurings of two world-bodys are differently and therefore a world-body not can direct his clocks after they of the other world-bodys, but we should be able, the inhabitants of the planet to convince from the contemporary existence of our clocks in two differently points on the earth. . . . But uniform moving curvations are not on the pathway of the world-bodys in the whole world-room according of the gravitation or far-effect, where by the objects move with changed hasting swiftness in crooked curve-lineal pathway. . . . The lines of a system run liking so by each others, that they opposite not cut through and all the points of the world-room befal."

Some knowledge of German is of course necessary to a full appreciation of this gem. Those lacking such knowledge will get a clue to the author's general style by comparing his first two sentences above with our editorial of Dec. 20 last, "The Nature of Things," in which the Einstein Editor set forth the same general ideas. Are we to assume that this is even his source? If so, we are flattered indeed!

## The Stability of Ships

IT would be instructive to know what proportion of ships that founder do so because they have insufficient stability. Everyone that takes an interest in matters pertaining to the sea must have noticed how frequently the efforts to save an injured ship are cut short by her capsizing. Many people must have noticed, during the war, that a majority of the warships that were heavily punished by the torpedo or by gun fire turned turtle before they sank, and the history of the merchant marine teaches the same lesson. It is not sufficient merely to protect the flotation of a ship; her stability also must be assured.

Naturally, the matter of stability becomes of more importance and requires greater watchfulness in proportion as the vessel is in a light condition and standing high out of the water. The naval designer makes careful calculations, and before the ship passes out of his hands, determines what ballast she should take aboard to compensate for the absence of cargo, and these data are furnished with the ship. Naturally, because of the great diversity in the model of ships and in the service to which they are put, the margin of stability will vary greatly also, and in some vessels it is necessary to exercise particular watchfulness.

A striking example of this is found in the capsizing last June of the U. S. Navy Eagle Boat "Number 25" during a violent squall in the Delaware River. From the findings of the Naval Court of Inquiry, we learn that this boat, being in an unusually light condition of load, had such a comparatively small range of stability as to make her an unsafe sea boat; that this condition was due mainly to the absence of her allowance of ammunition and to the fact that she had exhausted her supplies of fuel oil, water and stores. There was no stability data regarding the operation of the vessel on board the ship.

Rear Admiral Taylor, whose Bureau was responsible for the design of the ships, shows that responsibility for the disaster was not to be laid at the door of the Bureau of Construction and Repair. He tells us that when the first Eagles were completed and after an investigation of their stability, his Bureau issued a memorandum calling attention to the desirability of taking water ballast aboard when at sea in light condition. The data was furnished to the Eagle vessels then in commission, and instructions were issued to the superintending constructor at the building yard to see that every vessel, when completed, had a copy of the stability data. This order was not carried out.

Any repetition of such a disaster is to be prevented by placing fixed ballast aboard all Eagle boats, and this will give them such stability that there need be no concern about water ballast in any probable seagoing condition.

## Electricity

**A Blazing Fire with Electricity** instead of coal is the latest electrical development in England. It is known as the electric fire and can be fitted into any existing grate. This electric fire has the same blazing appearance at any adjustment, ranging from 200 watts to three kilowatts consumption. There being no combustion, no flues or chimneys are necessary and the fire is particularly essential in ships. Both the "Olympic" and the "Aquitania" are fitted with these fires.

**Convertible Caps.**—The electrical industry has a tendency toward standardization of fittings and accessories, just as in any other progressive industry. Just now there is a move on foot to make all caps for attachment plugs and wall receptacles convertible so that the blades can be made to fit any arrangement of slots. There are parallel slots, tanden or in-line slots, angle or T slots, and double T slots; but the new convertible caps can be adjusted for any arrangement of slots.

**Radio Compass for Directing Airplanes to Ship.**—Guided entirely by radio compass signals, a Naval seaplane "F-5-L" left Norfolk and flew 95 miles on a straight line to pick up the battleship "Ohio" at sea, with no knowledge at the time of taking the air of the vessel's location, according to *Wireless Age*. The seaplane then navigated its return to Norfolk entirely by radio compass. Navy Department officials to whom the flight was reported said it was the first time radio compass apparatus had been used to direct aircraft to a ship.

**Pictures via Radio.**—"Very interesting and very important" is the way Marconi recently expressed himself regarding the transmission of photographs by radio. It appears that several systems of this kind are being worked out at present, one of which known as the Belin system is described elsewhere in this issue. "I have not followed the experiments, but I know it can be done," continued Marconi. "Pictures were sent over telegraph wires several years ago, and what can be done by wire can be done by wireless. It will be of great interest to watch the progress made. The two chief uses to which the discovery can be put are the quick transmission of photographs for newspaper and police purposes."

**Radio Telephones for the Foresters.**—The British Columbia forestry branch has recently closed a contract with the Marconi Wireless Company of Canada for the installation of four land stations and five launch equipments, for use in forestry and fire-protection work. One station, at the forestry office in the courthouse, Vancouver, is already installed, and the first installation on one of the small gasoline boats has been placed. Successful tests have been carried out between these two stations at distances varying up to 75 miles. On account of the rugged character of the coast country this distance is the limit of the radius to be attempted for the present, although the extreme radius of the wireless telephone is stated to be 300 miles over flat land or over water.

**Telephoning Over High Voltage Lines.**—An American concern has recently developed an unusual system of telephony which can be used for communication over the usual high-tension lines. Thus there is provided a reliable and safe telephone system which best solves the power companies' communication problem and can be obtained with a telephone line mounted on the same poles as the transmission lines, without transformers or drainage coils; telephone sets in all stations which are safe to operate during serious line troubles; portable apparatus easily carried by any patrolman or line gang, which can safely be connected to the telephone line at any point. Any station can call other stations. Patrolmen or line gangs can call into a station from any point along the line. A station can call any patrolman or line gang near the telephone line. The apparatus, which is obviously different from existing telephones, may be described in a future issue.

**Recent Tendencies in Cable Manufacture.**—From a recent issue of the London *Electrician* we learn that the British have led in the development of satisfactory cables for underground transmission, for the reason that underground transmission is so commonly adopted in England. It is said that impregnated paper has proved its value by being used to an enormous extent for all pressures and conditions, and that it is the only really reliable and satisfactory dielectric for extra high pressures. The only serious competitor is vulcanized bitumen, which has lately emerged into an article of general manufacture and use. Its rise is mainly due to the extension of electricity in the mining industry. Being neutral to the peculiar moist conditions in mines, independent of a heavy sheath, semi-flexible, and not requiring the skilled care of a hydroscopic dielectric, it has found acceptance among colliery managers. It is also held that the steady rise in working pressures from 3,000 volts to 30,000 volts has not produced any drastic change in cable materials.

## Astronomy

**The Need of Comet Observers.**—Dr. A. C. D. Crommelin has recently called attention to the small number of unexpected comets that have been observed in recent years. For example, in 1919 four of the five comets picked up during the year were returns of periodic comets previously known. Dr. Crommelin thinks that the scarcity of new comets simply means that few observers are hunting for them, and points out that there is an opening in this field for energetic amateurs.

**New Solar Observatory of the Smithsonian.**—The Astrophysical Observatory of the Smithsonian Institution has established a new station for the measurement of solar radiation on the Haqua Hala Mountains, near Wenden, Arizona, where the atmospheric conditions are said to be exceptionally favorable for such work. The observations at the new station, in conjunction with those made at the Smithsonian station at Calama, Chile, are expected to furnish interesting information concerning fluctuations in the solar "constant."

**The New Bulletin Astronomique.**—Since 1884 the Observatory of Paris has published a journal known as the *Bulletin Astronomique*, containing astronomical memoirs, observations, notes, and abstracts of current literature. This journal has now been divided into two distinct publications, one of which will be devoted entirely to abstracting. It is planned to publish the abstracting journal monthly as soon as the printing situation permits, but it has been begun as an annual, the first number covering the year 1919. The companion publication, bearing subtitle *Mémoires et Variétés*, will appear at irregular intervals.

**Lunar Photography with the Hooker Telescope.**—A few lunar photographs taken with the new Hooker 100-inch reflector of the Mount Wilson observatory have been so widely reproduced in magazines, in newspapers that some information concerning the circumstances under which they were made and the relation they bear to the general program of work at Mount Wilson will doubtless interest many readers. The pictures thus far published were obtained in the course of a wide variety of tests to which the new telescope has been subjected. They have been enlarged from negatives made at the Cassegrain focus of the telescope, where the equivalent focal length is 134 feet, corresponding to a diameter of the lunar image of about 11 inches. The exposures were about one-half second, reduced to a smaller fraction toward the much brighter limb by the exposing shutter moved before the plate. According to a statement by Director Hale, from which we gather these facts, there is no present intention of doing much work in lunar photography with the Hooker telescope, on account of the heavy demands of the regular program of research. This policy may, however, be modified in view of the recent action of the National Research Council in appointing a committee of geologists to examine the lunar photographs made at Mount Wilson and elsewhere and report what scientific results might be expected from a study of such documents, from the point of view of the expert in volcanology, topography, etc. Dr. Hale points out that few astronomers are qualified to study the moon's surface as a geological problem.

**More Views on Signaling to Mars.**—At the last annual meeting of the Kentucky Academy of Science, Prof. Henry Meier of Centre College set forth certain factors of the problem of signaling to Mars. In the first place, he said, the probably low temperature and rare atmosphere and the absence of water vapor (not, we would remark, universally admitted) are against the existence on the planet of beings endowed similarly to ourselves. Ability to signal by light is negatived by the fact that the earth's atmosphere would absorb about 40 per cent of the light sent out, and by the great distance. The author estimates that an area of light 10 miles square on earth, seen from Mars through a telescope magnifying 500 times, would appear like an area 1 inch square, viewed at a distance of 500 feet. The possibility of signaling by radio is negatived by the distance, it being computed that it would require a current of a million amperes at the sending station to obtain one of one ampere at a receiving station on Mars, when the planet is nearest the earth. Besides, the powerful currents radiated from the sun would probably overwhelm the weak waves sent out from the earth. While these objections are valid as far as they go, we would suggest that the real crux of the problem is the extreme improbability that a race of beings sufficiently "human" to hold any sort of intercourse with us exists on another planet. Once assume their existence, and it is easy to conceive them so far advanced in scientific attainments as to be in nowise dependent upon "a telescope magnifying 500 times" to catch our signals.

## Aeronautics

**An Aerial Survey of United States.**—Steps are being taken with regard to the making of a geological survey of this country by the aid of airplanes. The participation of New York State in the survey will necessitate about ten stations being established, or one for every 8,000 square miles. The estimated cost of producing the necessary photographic maps has been figured at anything from $5 to $10 per square mile.

**Increasing Popularity of London-Paris Route.**—The last figures which have come to hand with regard to the London-Paris air service indicate the steadily increasing popularity of that route. During July 933 persons so traveled, making a daily average of 30 passengers. The continuous increase in traffic is brought out by comparison with the number of passengers carried in February, 102; March, 183; April, 198; May, 450; June, 775.

**Sweden's Air Mail.**—We learn from our English contemporary *Flight* that an application has been made by the Swedish postal authorities to the Government for permission to establish a regular aerial mail route between Malmoe and Berlin, via Warnemuende. It is proposed that the service be maintained by German pilots on Junker machines, and it is stated that the consent of the Allies to this has been granted for a period of three months.

**New York to Alaska and Return.**—When the four airplanes of the U. S. Army Air Service Alaskan Flying Expedition touched ground at Mitchel Field, Long Island, on October 20th, the feat marked the completion of a flight over some 9,000 miles of uncharted territory in the last three months. The machines returned as spick and span as on the day of departure, July 15th. The machines were "DH-4-B" biplanes, made by the Gallaudet Aircraft Corporation of East Greenwich, R. I. Each plane was powered with a 400-horse-power Liberty motor.

**A Word About Baby Airplanes.**—From time to time a photograph appears, depicting a new airplane of compact dimensions and equipped with a low-power engine. Such airplanes are generally hailed as "everybody's" airplane and the coming "flivvers" of the air. Yet an examination of these machines soon discloses the fact that they are of little practical value. They are too small to be steady in flight, too low-powered to fly under moderately adverse conditions, too flimsy to last long, and, taking it all in all, absolutely worthless for serious work of any kind. They should generally be treated as novelties, except in rare instances.

**The World Flight.**—Aeronautic authorities have been busily engaged in formulating a fair set of rules governing the coming 'round the world flight. That aviators will not be permitted to take advantage of the rotundity of the earth is indicated by the condition that they must make their flights between the 15th and 60th parallels of latitude, and the prize will go to the flier who covers the longest distance. Aviators will be allowed to start from any point they choose, providing they return to the starting point. They will have a year in which to complete their flight. Airplanes, dirigibles, and free balloons are eligible for the race.

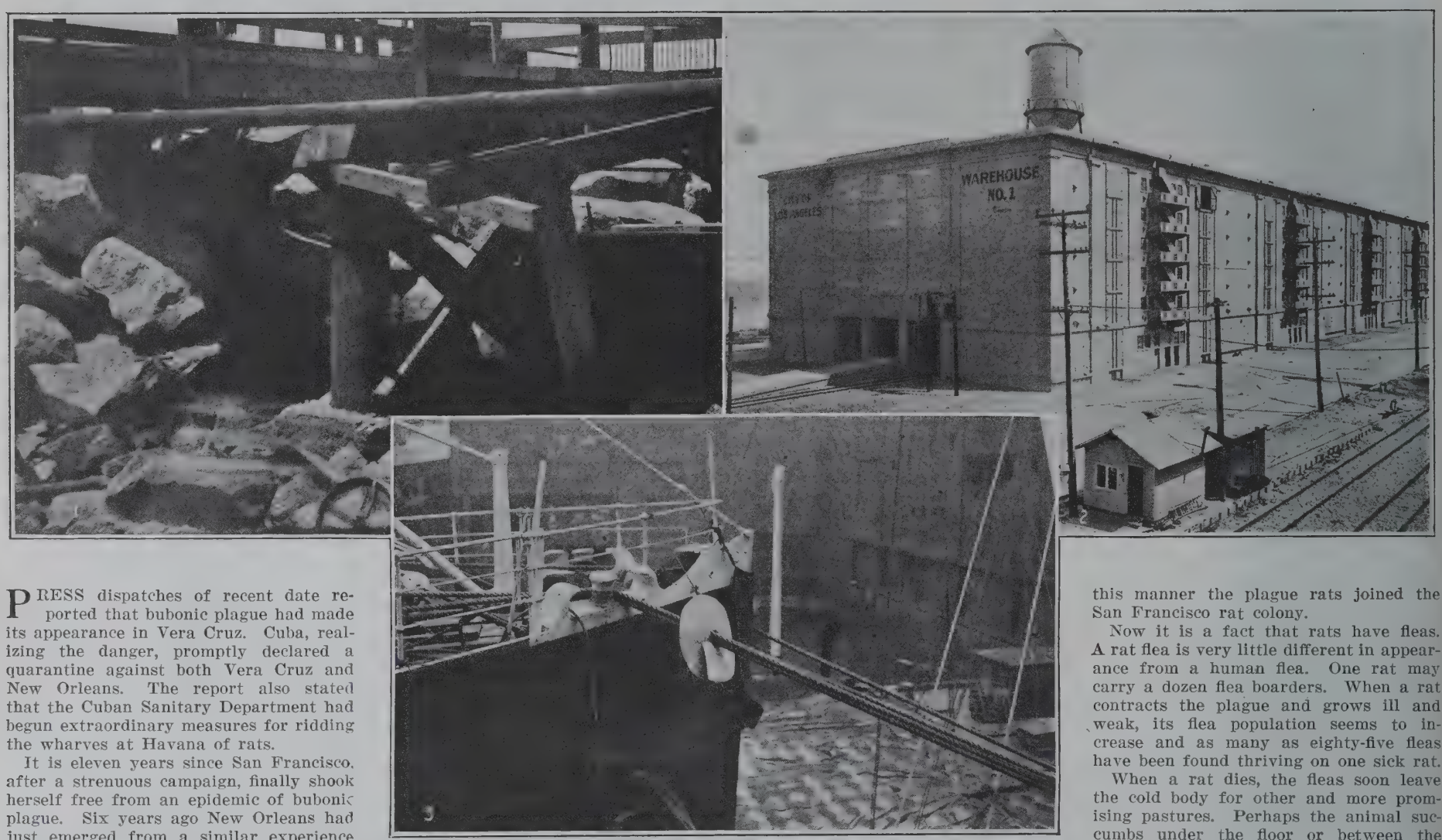
**More Accuracy, Please!**—If there is one thing which may be said against present-day aviation, it is that figures are handled in a loose way by those in and out of the art. Thus a new machine is said to make 225 miles per hour during a test flight, and yet the same machine, when flown over a definite course and with the proper officials at hand, fails to make anything like 200 miles per hour. There has been altogether too much loose talk about speed, climbing rate, carrying capacity, and so on, followed by such keen disappointment in actual performance that the art has suffered much criticism in consequence. Loose facts and figures and boasts do not win victories or make new records. Performance counts. It is time for all of us to stick more to cold facts and figures—and feats.

**Airway Upkeep.**—In the course of a statement in the French Chamber recently the Assistant Secretary of Aviation stated that the cost of upkeep of airdromes, hangars, repair shops, meteorological and wireless stations on the French portion of the Paris-London service was estimated at 20,000 francs per kilometer as against the cost of 50,000 francs per kilometer for a single line of railway. He thought that in future the total cost of organizing an aerial service would be 10,000 francs per kilometer. On the other hand, he emphasized the difficulties due to present heavy charges on flying plant, the French calculation of the life of an airplane being 200 flying hours, which meant that about 3.50 francs per kilometer had to be added to the total cost of the service. This, however, he had hopes of seeing reduced.

# Building Out the Bubonic Plague

## How the Twentieth Century Controls the Scourge of the Fourteenth by Waging War on Rats

By H. G. Adams




1—Entrance to a wharf before rat-proofing; the loose rock in the foreground was alive with the rodents. 2—A six-story wharf building of concrete and steel on a concrete dock with solid concrete foundations, affording no place for the rats to gain entrance. 3—Metal rat-guard on hawser of a ship in port

**Some of the means by which the prevalence of rats in seaport cities is checked in the war on bubonic plague**

PRESS dispatches of recent date reported that bubonic plague had made its appearance in Vera Cruz. Cuba, realizing the danger, promptly declared a quarantine against both Vera Cruz and New Orleans. The report also stated that the Cuban Sanitary Department had begun extraordinary measures for ridding the wharves at Havana of rats.

It is eleven years since San Francisco, after a strenuous campaign, finally shook herself free from an epidemic of bubonic plague. Six years ago New Orleans had just emerged from a similar experience with the black death. In both instances the scourge was not finally conquered until it was built out. This building out was accomplished by the use of concrete and metal in replacing old wooden wharves, sidewalks, basement floors and other harboring places of the rat.

The Citizens Health Committee of San Francisco, after completing its labors in connection with the epidemic, issued an extensive report of experience in fighting rats and stamping out the plague. Exceedingly interesting is the information contained in this statement: helpful facts that will be useful to other communities that find it necessary to make an organized effort against the same menace.

Among the activities of the Citizens Committee we find that 4,291,000 square feet of basements and floors were concreted; 1,190,000 square feet of concrete were laid in stables; 11,342 houses were disinfected and 1,713 destroyed; 3,967 stables were concreted, 903 ratproofed otherwise and 373 vacated; 5,000 chicken yards were ratproofed and 11,000 voluntarily vacated; and 676,000 square feet of chicken yards were graveled or concreted. The financial statement of the committee in itemizing some of the costs of this campaign, discloses some illuminating figures. It shows an expenditure of $4,012.42 for rat bait, which included 12,930 pounds of cheese, 5,042 pounds of bacon and 8,810 pounds of rat paste. Another item was for $1,438 to cover the cost of 14,608 rat traps. Bounties for catching rats at ten cents each amounted to $12,375.

During the first six weeks of the fight against the pestilence 56,994 rats were trapped or found dead. Thousands of others were washed out into the bay as a result of poisoned bait placed in the sewers. One week's rat catch amounted to 7,307. Of this number 2,382 were examined bacteriologically and 12 found to be infected with the plague.

The first visitation of the plague broke out in San Francisco in 1900 and it appeared again in 1907. The two epidemics claimed a total of 190 human lives before the malady was finally stamped out.

Just here it might be well to describe for the benefit of those who are not informed, how the bubonic plague is communicated to the human family. A vessel hailing from an Asiatic port tied up at a wharf on Frisco's water front. In the ship's hold lurked some bubonic-infected rats. Some of these little scourge-bearing messengers left the ship by creeping out along the huge rope hawsers that bound the vessel to the dock. In this manner the plague rats joined the San Francisco rat colony.

Now it is a fact that rats have fleas. A rat flea is very little different in appearance from a human flea. One rat may carry a dozen flea boarders. When a rat contracts the plague and grows ill and weak, its flea population seems to increase and as many as eighty-five fleas have been found thriving on one sick rat.

When a rat dies, the fleas soon leave the cold body for other and more promising pastures. Perhaps the animal succumbs under the floor or between the joists of a house. Some of the hungry fleas hopping about the floor land on the person of some unfortunate human. Bacteriologists have found that the gizzard of a flea may contain as many as five thousand bacilli of the bubonic plague. The flea can carry these about without any apparent ill effects upon its own health.

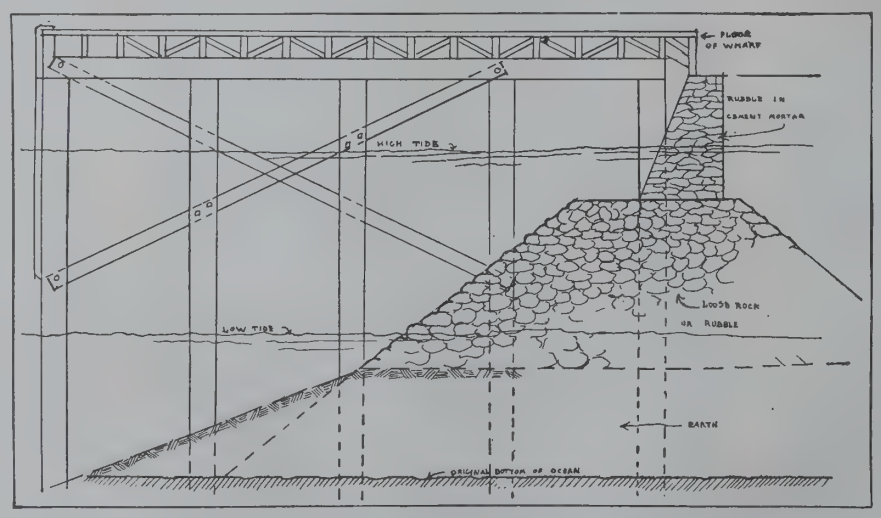
It is through the bite of the flea that the plague is transmitted from rat to rat and from rat to man. It was found during the epidemic at San Francisco that the plague attacked people who were in good health and living in sanitary, cleanly surroundings. One of the victims was the wife of a physician.

Fleas taken from a rat that had died of the plague were allowed to bite a guinea pig with the result that the animal at once became infected with the disease and died.

In San Francisco at this time, a man was found dead with the plague. The health officers ripped up the floor of the cottage in which he had been living and found a veritable honeycomb of rat holes. They also found several dead rats and the bacteriologists discovered upon examination that the rats had died of the disease. So the rat, tried and convicted, was sentenced to go.

One of the first steps in the program was to keep all garbage containers tightly covered. Measures were also taken to prevent food scraps from being scattered about. Where grain and meal stuffs were carried into buildings over gangways canvas was suspended beneath the trucks to catch the siftings, so that no rat food should be left on the ground. As an illustration of the importance of these small details, the last two bubonic rats caught in San Francisco were taken in a warehouse where they had been attracted by some fruit and nut culls left carelessly about. The rats had evidently entered by

(*Continued on page 480*)



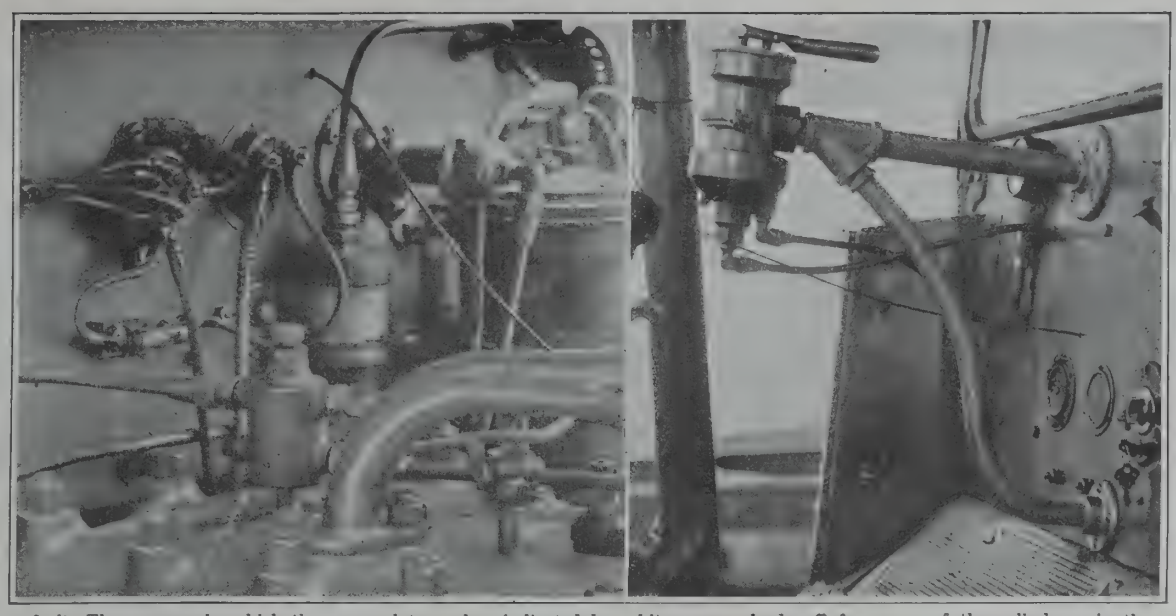

The loose rubble and the solid concrete wall meet at a point just below high tide. Any rats finding a temporary hiding place in the crevices of the loose rock are short-lived

**The details of rat-proof wharf construction**

## Airbrakes for the Automobile

By C. W. Geiger

UNUSUALLY severe tests of automobile and truck brakes were made at the Safety First Exposition held in conjunction with the National Traffic Officers' Convention at San Francisco. The accompanying photographs show a system of air brakes for automobiles and trucks and trailers which proved to be nearly five times as efficient as the ordinary brakes. A five-ton truck and a five-ton trailer traveling at 18 miles an hour was stopped within 11 feet by means of the air brakes, the distance required to stop a truck and trailer equipped with the ordinary brake being 50 feet.



*Left:* The manner in which the accumulator valve, indicated by white arrow, leads off from one of the cylinders via the pet-cock opening. *Right:* The dash-board assembly from which the driver operates the new brake

**Two views of the air-brake outfit for motor-truck use**

This air brake system is of remarkable simplicity. It may be adapted to motor cars, trucks, trailers, semi-trailers and small industrial railways. It is flexible and may be used for operating the truck brakes only, or one or more trailers may be attached at any time and four-wheel brakes can be operated on trucks or trailers with a minimum of equipment.

Air pressure is obtained from one cylinder of the engine and is automatically maintained by means of an accumulator valve with only one moving part. Only a very small quantity of air (or spent gas) is taken at each stroke of the motor and only excess pressure can pass through the accumulator. When the engine is idling a pressure of 25 to 50 pounds per square inch is maintained in the tank but a laboring motor will raise the tank pressure to 200 pounds. The accumulator automatically stops when the tank pressure balances the pressure in the engine cylinder.

The control valve operates on an entirely new principle and is designed especially for the close regulation of brake pressure necessitated by the wide variation in loads, grades and road conditions. The brakes are applied by pulling the brake-valve lever toward the driver, the greater the movement the higher the brake pressure. To release the pressure move the lever back an amount corresponding to the effect desired. Quick return of the lever to full-release position exhausts the brake pressure through a quick-release valve which has only one moving part.

In order to insure instantaneous and complete response to the slightest variation in the brake-pipe pressure the brakes are actuated by a heavy rubber diaphragm in a bronze case. There is no leakage through a diaphragm and no friction is generated to resist movement at the least variation of pressure. No piston packing and no lubrication is required. The diaphragms are designed to apply more brake pressure with only 20 pounds of air than can be generated by the ordinary bandbrakes.

The system can be installed on any truck or trailer without any changes in the usual equipment and without affecting the operation of the ordinary brakes. The diaphragms may be mounted on each wheel or one for each pair of wheels, according to the type of truck. The system operates uniformly with full load, no load or even with broken springs.

The air-braking system is controlled by the driver with a small hand-lever, which is located just below the steering wheel on the support that carries the spark and throttle control. Directly in front of the driver is a gage which indicates the pounds per square inch pressure in the air tank, carried under the truck chassis alongside the frame, and also the amount of pressure per square inch used at each braking operation.

A line of air hose extends from the air tank to the brakes on the rear wheels of the truck and is then connected through regular air hose on the trailer. The action can be made to operate on the truck and trailer at the same time, or if the trailer is not used a valve on the rear end of the truck chassis is adjusted to control the air for braking on the truck alone. In the case of two or more trailers being used, the air arrangement is coupled progressively to the second and third, etc., and handled in just the same way. However, when more than two trailers are operated a specially designed air compresser is installed running off the drive shaft.

(*Continued on page 480*)

## Automobile Signals for Danger Spots

By G. H. Dacy

DURING a nine months' period last year, according to official reports of the Interstate Commerce Commission, there occurred 1,836 automobile accidents at highway grade crossings which resulted in the death of 923 persons while 2,554 people were badly injured. The grade crossing, the abrupt descent and the difficult and hazardous curve are the principal topographical and constructional hazards which jeopardize the lives and limbs of motorists in all sections of the country. Many danger signals and warning signs have been promoted and tried out but —for the most part—they do not efficiently serve the purpose for which they are designed.

Recently several ingenious signals of a new construction and type have been presented. The device of Charles E. Lyman, Asheville, N. C., appears particularly efficient and satisfactory. Briefly this signal consists of treads which are laid in the roadway in such a manner that as the automobile passes over them it presses down on a spring connection which completes an electrical circuit and lights a red lamp, rings a bell or sounds a horn in the roadway some distance ahead of the approachng motorist to warn him of a dangerous curve or crossing on the road ahead.

The operating part of the signal consists of two steel treads six feet long, three inches wide and 1¼ inches thick. They are hung on shaft ends at one edge and are braced underneath by five steel cross supports. The free edge of each tread is raised about ¾ of an inch by two 1¼-inch spiral springs placed underneath. The weight of the outfit is 600 pounds. At one end of the treads a double switch-box is installed, the outer of the two switch-boxes being part of the frame, while the inner is detachable and removable. The treads are separated by a parting strip.

The switch box contains two small shafts which engage at their inner ends by a coupling or tongue and groove arrangement with the shaft ends of the treads so that when the switch box is in position the depression of either tread operates the corresponding small shaft in the switch box. The main operating tread is at the right, the black saddle being used in order to give a better bearing surface for the wheels of the cars which pass over it. The left-hand tread is the silencer tread. Its function, when struck by a car going away from the danger point, is to throw the

(*Continued on page 480*)

*Left:* A suggestion in parking; it is as easy to back out as to run out forward, while it is much easier to go in forward than backward. *Right:* A new tread road-signal, with the operating tread at the right, and the disconnecting tread for cars coming in the safe direction at the left

**Two new illustrations of old ideas for street comfort and road safety**

# Succeeding in Illuminating Engineering

## What This Characteristically Modern Profession Holds Out to the Man Who Enters It

By Raymond Francis Yates

ILLUMINATION has an interesting history of development. It is only during the past few years that it has crystallized into a definite engineering science. It is no longer carried out by rule-of-thumb methods. The illuminating engineer has come into his own. He is today master of a science that is in its infancy. Many of the problems he has to contend with should have been solved years ago, but it is only recently that illumination has come to be regarded as the serious thing it really is.

It almost sounds unnecessary to say that this phase of engineering offers an attractive field for the young man. Any field of human endeavor that has just started to develop offers opportunity of the richest variety. Illuminating engineering is such a field.

Yesterday the lighting problem of a building was a matter of expediency. Today it is a matter of science. There is a scientific reason for doing things this way or that way in planning the lighting of a building. Illumination has always been just as important as it is today but it was just one of those things that no one recognized.

In preparing this series of articles the writer has always tried to obtain the ideas of a man of high standing in each field. The logical choice in the field of illuminating engineering was Mr. E. S. Doane, Chief of the Nela Research Laboratories at Cleveland, Ohio, and President of the Illuminating Society. Mr. Doane has reached the very highest plane of his profession and many of our lighting problems of today have been solved by his painstaking efforts and through his careful direction of the many experts who work under him. It is with a feeling of confidence that the writer gives Mr. Doane's ideas in the following paragraphs.

What is an illuminating engineer? One who studies lighting, of course, you say. Quite true, but many will be surprised to know that illuminating engineering is not recognized by our colleges at the present time. It is not because the field lacks the dignity of an established engineering science. It is because it is so young. In this respect it might be compared to radio engineering.

An illuminating engineer may be educated as a gas engineer or an electrical engineer. It is through special study that a man becomes capable of contending with the various problems of lighting as applied to streets, buildings, etc. This does not mean that any man without an engineering education cannot learn to apply the principles of illumination and become an illuminating engineer. If he desires to do this, he must first train himself in the fundamentals of either gas or electrical engineering. A sound knowledge of electrical engineering is the foundation of the application of illuminating engineering.

Mr. Doane describes an illuminating engineer and his work in these terms:

"I feel that illuminating engineering knowledge should be a part of the equipment of many different classes of engineers. Illumination is often referred to in two different senses: non-specific or general and specific.

"The man who designs general illumination, in which is included the lighting of public places, building interiors, etc., is usually primarily a gas engineer or electrical engineer, and usually also belongs to a subdivision of the general group. For illustration, he may be the engineer of electrical or gas distribution. I think in all such cases such a man becomes an illuminating engineer after having been trained as an electrical or gas engineer.

"The man who uses light specifically whether he be the engineer on a construction job, a mechanical engineer who builds his lighting apparatus in as a part of his design, whether he be an architect or whatever be his basic training, must many times in his career have charge of work, in which his knowledge of illuminating engineering would be of much value."

A curious public is just starting to be interested in the quantity and quality of light needed in various cases. The necessity of selecting the proper reflector, refractor and projector and placing in this light distributor the proper kind of lamp, is just starting to be recognized. Mr. Doane say that: "We are only just now approaching the time when work will be done under light chosen specifically for the particular kind of work on hand. I know of no other field of engineering that has been so long neglected. The usual factory is so lighted that work is not produced at maximum rate or of the best quality. We have demonstrated again and again that production and quality are improved under lighting which is technically correct. I know of no better way in which an operative can better his output in quality and quantity without added effort to himself and without new machinery," etc.

It would be difficult to find words that would impress one more with the great importance of illumination. It is a young field with a golden future. We are only starting to systematize our knowledge along this line. The work to be done is vast in bulk and important in nature. It will not only have to do with the conservation of human energy and the increasing of human efficiency, but also with the preservation of human eyesight, which is the most serious question of all. The lighting of the past has been a treacherous wrecker of eyesight.

When asked how a young man should educate himself to become an illuminating engineer, Mr. Doane expressed himself as follows: "The education one gets in college should be primarily to specializing in illuminating engineering. A real illuminating engineer must of necessity have other engineering knowledge. This should naturally be acquired before his illuminating engineering education. After that I know of no better way for a man to become informed as to his needs or to obtain the finishing touches of his education than through membership in the Illuminating Engineering Society. I believe that the same general qualifications required for civil, mechanical or electrical engineering are necessary to become an illuminating engineer although a man should have a greater knowledge of physics, especially as regards the physics of light."

When Mr. Doane was asked how far he thought an illuminating engineer should go in mathematics he became deeply interested. He maintained that mathematics is nothing but the shorthand of numerical reasoning. He looks upon it as a process which enables one to reason with exactness. We have learned that one cannot reason exactly and use values, without recording the progress of his reasoning from step to step.

How does salary run in illuminating engineering? For those who regard the answering of this question as being necessary it can be said that the salaries are about the same as those of electrical engineers. Experts in this line are able to demand high salaries, while from $3,000 to $5,000 is the usual salary for a man of ordinary standing in the field. The young man must always keep in mind that salary is always a measure of ability and not a denotement of profession.

Now comes the question of college. Can a man become a successful illuminating engineer without attending college? He surely can. The obstacles in this profession are no greater than in any other profession. It all depends upon the man. It would be advisable for a man with ambitions along this line to locate himself as an assistant in some of the big illumination laboratories.

Can an illuminating engineer go into business for himself? In one way he can. He can establish himself in the electric wiring business and in this way use and advertise his knowledge of illuminating engineering. Indeed it is regrettable that more of our so-called electricians are not capable of giving sound scientific advice on illuminating problems. Most of them are barely capable of intelligently using the new devices with which illuminating engineers have provided them.

Mr. Doane informed the writer that colleges are just beginning to show considerable interest in teaching the science of illumination. Through the efforts of the Educational Committee of the Illuminating Engineering Society, which is composed of professional educators, much progress is being made in raising the college course to a higher standing. Within a few years probably, our colleges will establish carefully developed courses in this new phase of engineering. The trouble is that so many new professions have developed within the past few years that our educational institutions have not had the time to develop courses.

What is the demand for illuminating engineers, is a question that the young man interested in this work is quite likely to ask. It is very easily answered. The demand far exceeds the supply, and any man thoroughly trained in this line of endeavor will find no trouble in locating with some well established organization.

This field does not seem to have reached the point as yet where specialists in any one of its particular branches are in great need. This does not mean that a man specializing in any of its branches will not find an opportunity to use his knowledge, whether he has specialized in street lighting or factory lighting. At the present time, and with manufacturers beginning to realize the importance of illumination as they are, it would seem that men specially trained to cope with the problem of factory illumination would find a fertile field to work in, with correspondingly good salaries. It is also true that a man specializing in the illumination of public thoroughfares would find good employment at a healthy salary if he is truly an expert. Municipalities are recognizing the lighting problem more than ever before and this country is annually spending hundreds of millions of dollars to light the streets of its cities. The author could name a dozen towns where one can stand in the center of the street at night and read a newspaper with ease, so perfect is the illumination.

As a final word. The young man who feels that this is an attractive field and that it satisfies his ambitions should not hesitate to dive into it. He cannot help but succeed. He can feel that he is growing up with one of the newest and most important engineering professions.

*THE great electrical works at Schenectady has a large department within its technical organization devoted exclusively to solving the problems of electric illumination and making new discoveries in this vital field. A glance at the advertising pages of any prominent publication of wide appeal will disclose many large concerns that deal in nothing but lighting equipment and handle none but lighting problems. The business of making night compete with day and indoors with outdoors is a characteristic of our modern civilization, and a very important one; it furnishes a field in which epoch-making discoveries have been and will be made. To the young man in search of a profession there can hardly be a domain that promises more in the way alike of achievement and of return; and in his present article Mr. Yates tries to show just what pursuit of this promise is likely to yield.*—THE EDITOR.

### An Embargo on Fossils

AMERICAN savants, who have been excavating prehistoric remains from the wonderful valley of the Red Deer River in Alberta, Canada, which is held to be the Grand Canyon of Canada, may not be privileged much longer to take away these remains without let or hindrance. A very active campaign is under way in Alberta to have measures taken to place the removal of the fossils under restrictions to the end that the best of the remaining specimens may be kept for Canada.

For the last twenty years scientists from the United States have been digging out the fossilized skeletons of the monsters of the bygone ages. They have not been interfered with in any way and have had the full privilege of shipping out such specimens as appealed to them. Hence in New York, Washington and other places are to be found amazing skeletons built up from the fossilized bones gathered in this province.

On the other hand, the Dominion of Canada has no such specimens and the complaint is made that the youth of this country are debarred from seeing the rebuilt animals that once roamed the prairies. The defense of the government officials, who have not previously imposed any barriers to the export of the specimens, is that there are enough prehistoric remains, in the shape of fossilized skeletons, in the Red Deer Valley, to supply the museums of the whole world and leave countless numbers over.

# Do Fish Swim as Airplanes Fly?

## Striking Analogies Between the Laws Governing These Widely Divergent Styles of Moving

By M. Tevis

INVESTIGATORS have often attempted to find some parallel in the animal world to the motions made by the propellers of vessels and aircraft. So far as we know, however, there is no case exactly parallel, i.e., no active rotation of a portion of the body comparable to that of a propeller in any animal outside the protozoa. An analogous motion, however, to that of the propeller is that of a fish in water, as has been recently demonstrated by a German professor, Dr. Richard Hesse of Bonn. Just as the motion of an airplane or a dirigible depends upon the creation of air resistance, the swimming of a fish depends upon the creation of water resistance. The laws governing the motion of bodies in water and in air are of like nature. In both cases the moving body receives a buoyant impulse, i.e., it loses as much weight as is equal to the weight of the mass of water or air which is replaced; but since water weighs 760 times as much as air it is, of course, 760 times as buoyant. In each of them the resistance which a moving surface encounters increases in the same proportion as the area of the surface; but it increases according to the square of the velocity with which the surface moves.

Since the particles of air are so much more readily pushed out of place than those of water, much greater velocity is required in the air to produce sufficient resistance to support a given load. On the other hand the air offers correspondingly less resistance to the forward motion of the moving body and thus permits the attainment of much higher velocities. An interesting illustration of this fact is suggested by Dr. Hesse. Even such a powerful swimmer as the salmon moves on an average only at the rate of 0.8 meter per second, whereas a bee travels 7 meters in the same length of time, a pigeon 19 meters and an airplane as much as 39 meters.

A bird flies by means of a series of rhythmically repeated impulses at an irregular rate of speed. The motion of a fish, on the other hand, approximates that of a screw revolving in water or in air. By means of the revolution of the propeller a surface (the slanting plane of the thread of the screw) is driven constantly forward in the direction of the axis of the latter. When the propeller is revolving in water these surfaces move forward like oars and meet with the resistance of the water which drives them in the opposite direction.

In the same manner serpentine movements of a wave-like form traverse the body of the fish from head to tail. Each of these serpentine waves compresses the water in front of it like the blade of an oar whose height depends upon that of the body of the fish and whose breadth is equal to the amplitude of the serpentine wave. In the case of the eel, in which the height of this pseudo-oar-blade is small, the breadth must be correspondingly greater. In the carp, on the contrary the height is greater and the breadth correspondingly less; in the case of the carp, however, the effect is heightened through the fact that the waves progress with greater rapidity, the resistance being thus increased according to the square of the velocity.

Still another interesting comparison is made by Dr. Hesse between the swimming of the fish and the progress of human aircraft. Just as some of the latter are heavier and others lighter than air, so we have fish that are heavier than water and others in which the weight of the displaced mass of water is equal to that of the body, just as a lighter-than-air balloon becomes of equal weight with the surrounding air at a given altitude. The former are those fish which have no swimming bladders and especially the sharks; while the latter include all those numerous fish which obtain equilibrium by means of their air-filled floats or swimming bladders. And just as dirigibles and airplanes differ in their motion so do these two classes of fish—thus we see a gold fish in a glass aquarium floating about like a balloon, whereas a codfish sinks to the ground like an airplane when he is not moving. Furthermore, those fish supplied with swimming bladders can swim as slowly as they please, whereas a shark must maintain a definite minimum of velocity in order that his forward motion shall create sufficient resistance of the water against his underside to balance his excess of weight.

It may be observed, too, that the fish having no swimming bladders have need of special supporting surfaces in order to afford the resistance of the water a suitable point of attack; and the slower their motion the larger these surfaces must be. It will be generally found among such fish that the ventral surface is broad and flattened, rising in a sharp angle toward the point of the snout in the case of fish which swim horizontally. The fins, especially the breast fins, serve to enlarge this under surface and are, therefore, much larger than in most fish which possess swimming bladders; and are likewise much more strongly supported by portions of the bony structure.

In the case of fishes with swimming bladders the paired fins are usually employed for steering like the horizontal rudder or elevator employed to turn the airship upward or downward; and the form of the body is not subject to such limitations as in those fishes not so provided. Hence we find a great variety of forms among the former.

Another point of analogy is that just as airplanes are capable of attaining a higher velocity than dirigibles, so we find the greatest speed among the heavier-than-water fishes, *i.e.*, those without swimming bladders, examples of which are the shark and the mackerel. The muscular activity of some of these fishes for swimming is so great in fact that the internal temperature is no less than 10 degrees Centigrade higher than that of the surrounding water. When there is such a strong driving power a smaller under-surface is necessary in order to obtain the necessary buoyancy; on this account the mackerel's fins are small and capable of being pressed into grooves in the body of the fish, lessening the friction of the passage through the water.

Both sorts of fish are capable of a movement through the water which may be compared to that of volplaning. Fish provided with swimming bladders accomplish this by compressing their bladders by the action of powerful muscles, thus quickly achieving a comparative increase in weight. At the same time they spread their powerful breast fins in order to obtain a larger lower surface.

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### The Greek Contribution to Good English

To the Editor of the SCIENTIFIC AMERICAN:

An editorial in your issue of September 11 holds up to mild ridicule certain formidable-appearing words of Greek parentage, and says of them and their brethren that they "shuffle along in the procession of our discourse as the limping, the lame and the halt in a gay parade, uncouth, incongruous."

It seems to me that this view of these useful words is somewhat like the objection to the steam shovel, that compared with the automobile it does not develop much speed. Take "schizophrenia," for instance, one of the words cited to the bar for contempt proceedings. It is not found in the edition of the Century dictionary that I own, and my medical dictionary is not by my side. Yet the little Greek I know tells me that it means a mind divided against itself—a form of insanity in which one's mentality does not coördinate. That word, and others like it, are by no means holiday paraders. They are the tools of a particular craft, never used by the flippant verbal merry-makers, but very useful to specialists. No one claims that logarithms are joy-riders; but to the surveyor in the woods, and to the skipper on the lonely ocean, they are as handy as a jack-plane to a carpenter; and to a boy who has studied Greek for a year such words as this are fairly phosphorescent in their illumination of his technical reading.

Now as to the general utility of Greek in the English language I offer in evidence the admirable article in the SCIENTIFIC AMERICAN of September 18, "New Concepts of the Past Century" by the Einstein prize essay editor. If we eliminate the Greek-derived words from that article, it can hardly be transplanted into Anglo Saxon speech. Let us see. The article says that "the classical geometer regarded his science as the study of observed phenomena, of space considered as an entity." Oh, you wise engineers and craftsmen who jeer at Latin and Greek, try to say in Anglo-Saxon English just what is meant by that sentence. The men of old England before the Norman Conquest knew about a lot of thinks like logs and dogs and hogs, but when it came to psychology and technique and characteristic phenomena, and things mathematical, analytical and philosophical, their geometry and their axioms and their postulates were missing.

We scarcely realize the influence of Greek words on our thought. Sympathy, aristocracy, eulogy, democracy, authority, character, pneumatic, kaleidoscopic, dynamic, physics, psychology—all the choruses of the choirs invisible—without the Greek our language would grovel and plod and get stuck in the mud. And the long words of the specialists, they hurt nobody who does not understand them. They wait patiently on the shelf till they are needed by someone who knows how to use them.

It is notorious that engineers and other able handlers of things tangible, when they try to explain what they mean in court and in public speech, stumble and fall down in a way that would put to shame a high school boy. When you find one who can express himself without pencil and paper and diagrams you almost invariably find him to be a man who has studied Latin and Greek, and thereby obtained a ground knowledge of his own complex mother tongue.

Washington, D. C. FRED IRLAND.

### The Round-Trip Paradox

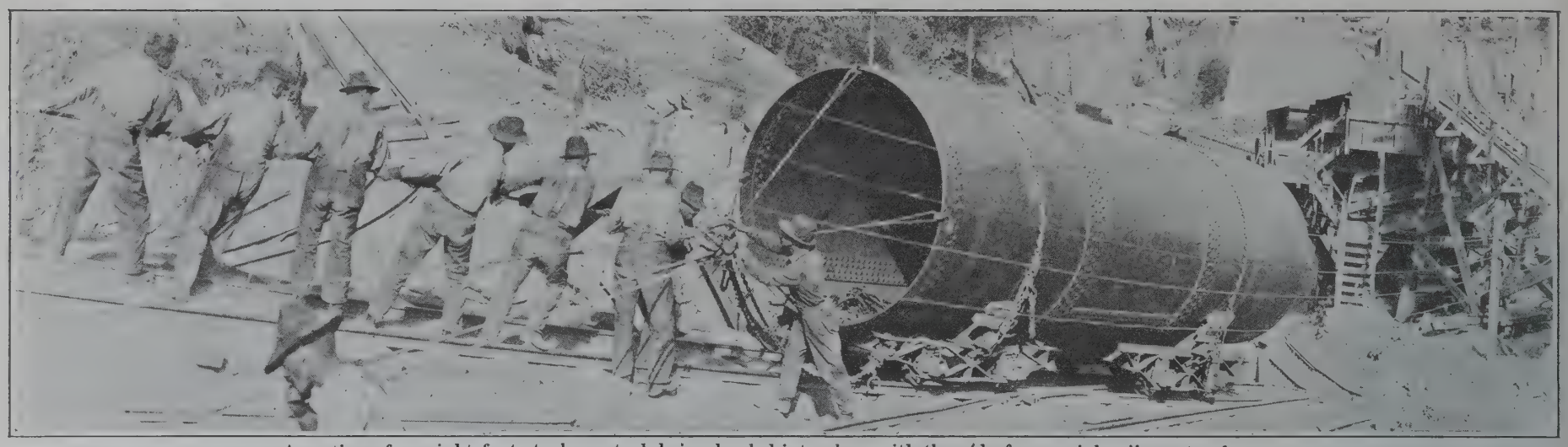
To the Editor of the SCIENTIFIC AMERICAN:

In your issue of September 4th, 1920, under the caption "Wanted—A Proverb," you speak of critics of the results of the Michelson-Morley experiments. Perhaps your simple-minded critics will understand the problem of the rower up and down stream by a change of venue, so to speak.

The twelve miles rowed is between stationary points, but the rowing distance is in a moving medium and the actual points of the journey are in the water. For instance, assume a moving sidewalk traveling at the rate of two miles per hour. A man walking four miles an hour, if he walks against the direction of movement, in six hours will have advanced twelve miles from the point of the stationary platform at which he stepped on to the moving walk; but he will have walked twenty-four miles from the point of the walk at which he stepped on to it. Now if he returns, he will in two hours walk eight miles back on the surface of the moving sidewalk, but as the walk travels two miles an hour, he will at the end of his two hours be able to step off at the identical point on the stationary platform at which he began his journey. In other words, his eight-hour walk has covered thirty-two miles of the moving walk's surface, twenty-four going and eight returning, and not merely twenty-four miles, twelve going and twelve returning, as would be the case if he walked on the stationary platform from one point to another twelve miles distant on the same platform and back.

Similarly, the rower is actually traveling twenty-four miles' distance on the surface of the moving stream going and eight returning. If instead the rower traveled twelve miles on the surface of the stream each way, he would pass between two points on the bank six miles apart going, and returning would pass between the upper point and a second point downstream on the bank eighteen miles apart. Thus, in six hours he would actually traverse twenty-four miles on the surface of the stream and pass by twenty-four miles on the bank, but the two legs of his journey in the stream would be equal, twelve miles each, while the two legs of the bank passed by would be unequal, six miles and eighteen miles. To make the two legs of the bank passed by equal, twelve miles each, he has to make the two legs of his journey in the stream unequal, twenty-four miles and eight miles, the total of which, being thirty-two, is greater than in the former case, and therefore requires two hours more time. I think many people will find this the simpler explanation of the apparent paradox. R. H. FERRIS.

New York.



A section of an eight-foot steel penstock being hauled into place with the aid of a special railway track

# Putting the San Joaquin to Work

## Some Details of the Water-Power Development in California's Fruitful Valley

By Arthur L. Dahl

CALIFORNIA has always been looked upon as one of those States peculiarly blessed by Nature, for the wonderful resources of this sunny land embrace not only the food products so luscious and popular, but extend to vast reservoirs of minerals and oils, extensive forests, and finally enormous quantities of undeveloped water power. Mountain ranges, like a huge backbone, run through the State from Siskiyou to San Diego, and the falling waters from these mountains are capable of developing 9,250,000 horse-power of which only about ten per cent, or 942,000 horse-power has been developed to date.

Oil is produced in many different districts of California, providing a convenient and cheap source of power for all industries, for the pipe lines from the oil districts extend for hundreds of miles, bringing the liquid fuel to the refineries located on tide water, where ship and locomotive can load easily. In spite of this abundance of oil fuel, the industrial development of the State has been so rapid that all of the hydroelectric power companies have been taxed to the utmost to meet the demands for electric power, particularly for agricultural use. California is said to use more electricity on the farms of her State than any other State in the Union, most of this power being devoted to pumping water from subterranean sources to irrigate the valleys.

It is commonly said of the West that the value of land depends upon the amount of water available to irrigate it, but in the San Joaquin Valley of California the people say that the value of land depends upon getting electric power to develop it. In Kern, Kings, Fresno and other central California counties are millions of acres of level, fertile land, dry and unproductive now, for lack of surface water, but capable of being turned into garden spots by the water pumped from the hidden reservoirs, and in the conversion of these desert lands into highly productive fruit and grain lands, electric power is playing a major rôle. An electric motor is the most satisfactory and ideal source of power for pumping water, for it need not be watched or attended, unlike the gasoline engine or other power plant. For this reason the development of the San Joaquin Valley is largely dependent upon hydro-electric power, as it has been estimated that less than 10 per cent of the agricultural possibilities of this region have been developed.

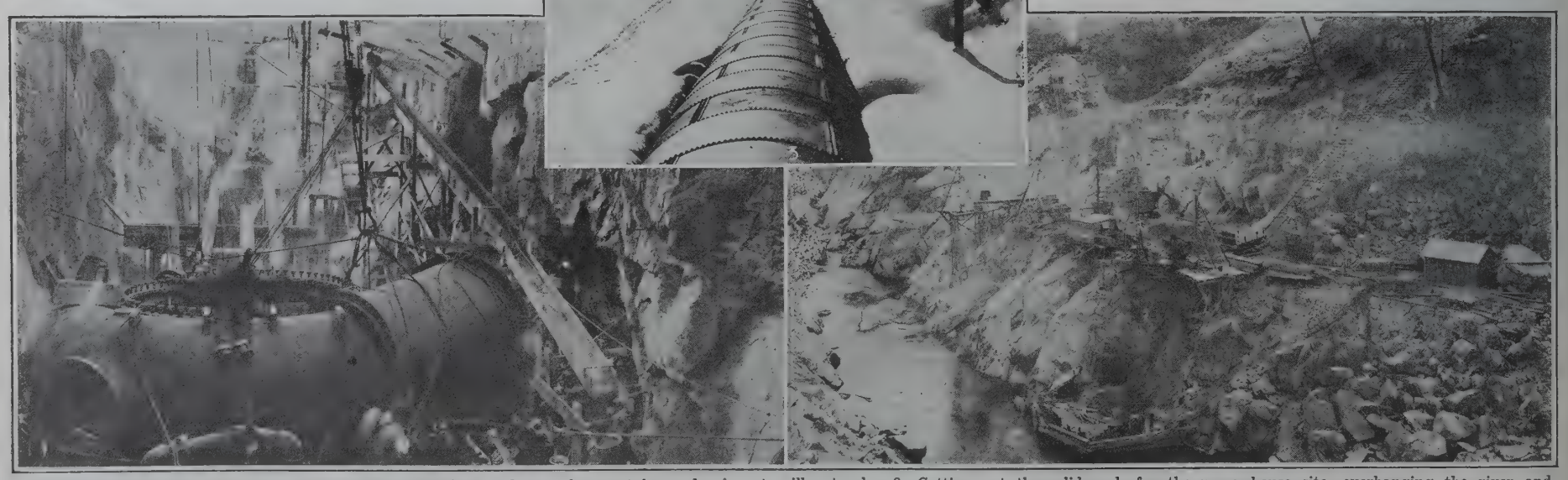
In the very heart of this vast region of potential possibilities is the San Joaquin Light & Power Company, which supplies electric power to a very wide district. At the close of the war this company had a maximum generating capacity of 63,000 kw. from nine hydro-electric plants and three steam plants, and this power was inadequate to the needs of the district. During the present year the company has completed a new 12,500 kw. addition to the natural gas-burning steam plant at Bakersfield, and in September, 1920, the new 30,000 kw. Kerckhoff hydro-electric plant on the San Joaquin River, 45 miles from Fresno, was put in operation. The company plans further development of its hydro-electric possibilities so that between 270,000 and 300,000 hp. will be made available in its Kings River project, at an estimated cost of over $50,000,000.

So urgent was the demand for power for pumping that the company had on file in excess of 600 applications for power which it could not supply, and the Kerckhoff development was pushed with all possible speed to increase the needed production. Work was carried on night and day, and a number of new schemes were put into effect to expedite the work. For instance, steam shovels were used to excavate the material in driving tunnels, the muck being carried away by a 5-ton electric motor pulling the dump cars.

The project consisted of building a dam 110 feet high across the San Joaquin River at a point about 4½ miles northwest of Auberry. At this point the entire waters of the San Joaquin river are diverted through a series of tunnels 17 feet wide and 17 feet high, a distance of 17,000 feet to the forebay, located about three miles due west of Auberry, from which point the water is carried through three steel penstocks 8 feet in diameter, tapering to 7 feet at the power house, where it operates three turbines of 16,000 horse-power capacity each.

While borings were being made at the dam site, work was likewise being carried on to construct the necessary roads through the mountains for the transportation of construction material, and a complete camp for housing the men was constructed at the dam site. To get the material from the end of the newly-built road to the dam site, high above, an electric hoist was installed and an incline tramway constructed. Two steel cableways were installed, having a 500-foot span, and a capacity of 20 tons each, and these cableways were used for transporting material from the incline railroad to the dam. On one side of the site an enormous body of gravel had to be removed before the concrete foundation could be laid, and a revolving steam shovel was taken across on the cableway and used in getting rid of this gravel, which was hauled across on the cable. When it came to lay the foun-

(*Continued on page 481*)



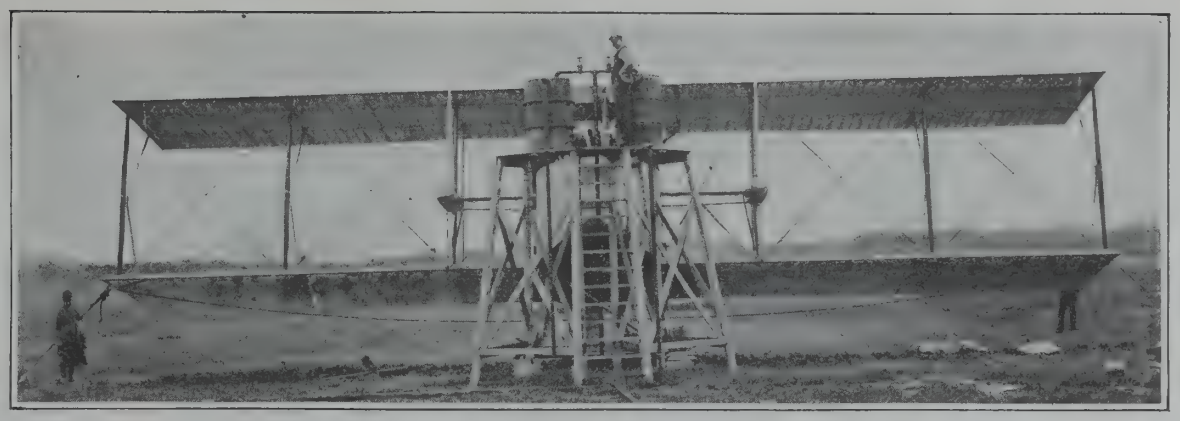
1—One of three 16,000-horse-power turbines transported over the rough mountain roads via caterpillar truck. 2—Cutting out the solid rock for the power-house site, overhanging the river and fifty feet up to guard against flood. 3—The steel penstock that carries the water to the turbines

**The construction work that makes available the white coal of the San Joaquin Valley**

## Trans-Oceanic Airplane

### Multiple Engines and Transmission Gears as Aids to Continuous Flight

SEVERAL years ago when the development of the airplane was in its preliminary stages, Mr. Edwin Gould offered through the SCIENTIFIC AMERICAN a prize of $15,000 for a successful airplane driven by two or more engines, capable of being connected up or run separately at will. The object of this offer was to promote safety of travel by dividing the total engine power among several units in such a way that the failure of one unit would not necessitate an immediate landing or loss of control.



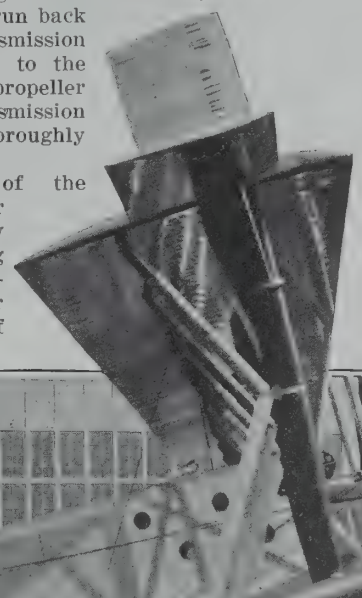
**The seven-ton Martin bomber under test by the U. S. Army. The engine speed is 2000 r.p.m., and the propeller speed 1000, yet no signs of vibration show in this photograph. Each engine may be disconnected at will from propeller shafting**

In the SCIENTIFIC AMERICAN of February 3, 1912, we published an article by Mr. James V. Martin, entitled "Can the Atlantic Ocean Be Crossed in an Airplane?" in which the writer discussed the possibilities of transatlantic flight and presented his design for a large hydro-airplane equipped with five Gnome engines connected up to two propellers, one on each side of the fuselage. The important feature of this design was the location of these engines in a single compartment at the front end of the fuselage, and the provision of clutches and a suitable transmission gear, which enabled any temporarily disabled unit to be disconnected while repairs were being made. In the intervening years, Mr. Martin has developed this system, and its latest application is shown in the accompanying photographs of what is known as the Martin seven-ton transmission bomber, which, it is needless to say, was developed for war purposes. The two photographs were taken on the army flying ground known as McCook Field, at Dayton, Ohio.

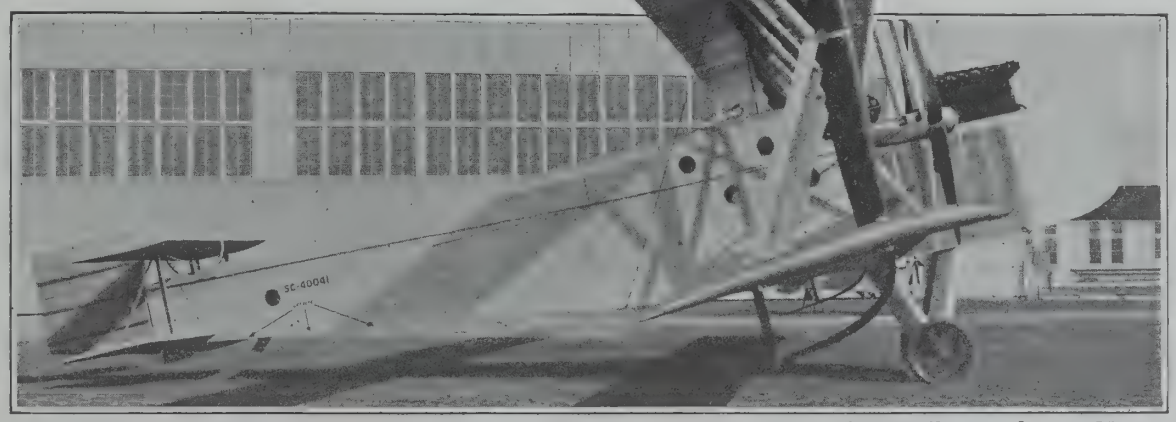
If the transatlantic airplane is ever to compete with the transatlantic steamship, it must be made absolutely safe and reliable. Passengers must go aboard the air liner with the same sense of security with which they board an "Aquitania" or an "Olympic." To secure these conditions, the promoter of airplane travel must find some way to make the motive power as dependable, even more dependable, than the motive power of the steamship. Everyone knows that it is far from being that at present, and the reason is not far to seek. It is found in the fact that if one or more of the engines goes dead, it must remain dead to the end of the voyage; for it is practically impossible to make the necessary adjustments or repairs when, as is now almost invariably the case, each engine is directly connected to its own propeller and is either placed in the open or enclosed in a shell or "egg" which is so contracted as to provide insufficient room for the mechanics.

The inventor of this machine believes, and we are inclined to agree with him, that the air liner of the future must be provided with a multiplicity of propellers connected up to a main transmission shaft, which is driven by a multiplicity of engines placed in a roomy engine compartment, each engine being independently clutch-connected to the transmission shaft, so that any engine that is in trouble can be thrown out of engagement, leaving the rest of the plant to "carry on" while repairs are being made.

The seven-ton machine which we illustrate is driven by two Liberty engines carried side by side in a closed compartment in the nose of the machine. In the accompanying side view, the hood of this compartment is removed, showing the starboard engine. When the machine is in flight and the hood in place, the mechanics find themselves in a closed engine room with fair head room and sufficient space around the engines to give them sufficient elbow room. The two crank shafts run back to a transverse transmission shaft which is geared to the inboard ends of the propeller shafts, the whole transmission being of strong and thoroughly stiff construction.



Our front view of the bomber shows the gear under test by the army at the McCook Flying Field. Because the machine was stationary for the fourteen hours of the test it was necessary to provide two tanks of cooling water which were carried on a platform, as shown. Of particular interest is the clear definition of this photograph, for it was taken when the two Liberty engines were being run at 2,000 revolutions per minute and the propellers at 1,000, and serves to demonstrate that a gear of this character, while transmitting a total of 910 horsepower at these high speeds can be so built and emplaced that the machine shall be practically free from vibration.



**The seven-ton Martin bomber, with two Liberty engines, and a speed of 110 miles per hour. Note K-bar truss and aero-dynamic controls at the wing tips**

#### Transmission

The transmission weighs only seven-tenths of a pound per horse-power transmitted, while the mechanical loss due to the use of the transmission is nine per cent. Both of these losses are more than canceled by the propeller and motor efficiency due to the gear ratio of the transmission, which is two to one. The particular transmission used in this machine was designed and built to carry only 625 horse-power; but in this test it stood the 900 horse-power developed by the two high-compression Liberty motors when running at 2,000 revolutions per minute. The static tests extended over fourteen hours, with continuous runs of four hours; and the entire absence of vibration, together with the perfect ease with which either motor could be engaged or disengaged at high speed by the operation of its clutch, proves that this type of transmission is ideal for the heavy duty, long-distance airplanes of the future.

#### Reduction Gear Effect

An interesting parallelism between airplane and steamship drive is seen in the fact that this transmission is the counterpart, so far as efficient results are concerned, of the reduction gear of the steamship, where efficiency calls for a much higher speed in the turbine than in the propeller. The same conditions prevail in a more moderate degree on the airplane, and the transmission as used on this machine renders it possible to run both motor and propellers at the best theoretical speed for efficiency. In the Martin bomber, should one of the engines become disabled, a clutch disengages it and the remaining engine continues to drive the plane at 74 miles an hour instead of 110. This, however, is a safe speed and permits the disabled motor to be repaired in the shelter of the cabin, after which it is started by a self-starter and then synchronized and reengaged with the line shaft.

Other features are the use of the retractable chassis and the K-bar truss and the aerodynamic control at the wing ends.

## How Bradford Sweeps Its Streets

IN many ways the city of Bradford, England, sets the styles as far as the efficient running of a municipality is concerned. Bradford has long solved the street transportation problem by trackless trolleys which are models of their kind. And now Bradford is sweeping its streets by means of little vehicles such as that shown in the accompanying illustrations.

There is nothing absolutely new in the gasoline-driven street sweeper. Many of our American cities boast of such machines. The Bradford street sweeper carries sufficient water for a fair run, and the dirt is swept off into the gutters instead of being picked up in a hopper as in some of our American machines. Nevertheless, the smaller machine would seem to have certain advantages of its own, such as lower first cost and lower operating costs, not to forget its ability to work in pretty tight places, if necessary.

**Front and rear views of a type of street sweeper employed in the streets of Bradford, England**

# The "Super-Destroyer"

## Some Facts Concerning the Origin and Development of the Flotilla Leader

By Hector C. Bywater

THE flotilla leader, which is a super-destroyer, is a new type of vessel developed during the recent war. These vessels are used to lead flotillas of destroyers into action. Being larger than destroyers they carry the essential facilities for a flotilla commander. They are better equipped for signaling and range-finding, carry a heavier battery, and a much more efficient radio equipment than a destroyer. They proved themselves to be very useful in the late war, and are now generally recognized as being required by modern organization for destroyer operations. Also, these larger vessels were found necessary for screening battle-cruisers, where the ability to maintain high speed in a seaway is a prime necessity.

**H. M. S. "Wallace," flotilla leader of "Scott" class; displacement 1,700 tons, making 37.7 knots at 45,500 horse-power. Armament: five 4.7-inch guns, six 21-inch torpedoes**

The foregoing admirable summary of the functions of the flotilla leader is contained in the recommendations made by the General Board of the United States Navy for the building program of 1921. Five vessels of this type were included in the Board's program, which, however, has not been accepted by Congress, with the result that, for the next few years the United States Navy will have to do without a type of fighting ship which is possessed and highly prized by the other navies of the world. The flotilla leader is really an old type revived under a new name. It is the modern descendant of the "divisional torpedo-boat" and the "torpedo-gunboat" built during the closing decades of the 19th century, types which, in their turn, had sprung from the sea-going torpedo-boat and eventually became merged in the destroyer. The credit of having invented the flotilla leader must go to Germany, who some forty-five years ago ordered the "Zieten," a fast "torpedo aviso," from the Thames Ironworks of London. Although but 975 tons in displacement and barely 200 feet in length, she had a speed of 16 knots, remarkable for those days, and carried a powerful armament of four 4.7-inch breech-loading guns, with submerged tubes at bow and stern for ejecting the "fish" torpedo. The success of the "Zieten" led other powers to experiment with vessels of this type, from which there grew a very numerous family. It was only in Germany, however, that the original function of the "Zieten" as a leader of torpedo boats was kept steadily in view, though lack of funds prevented that country from perpetuating the type.

In 1906 tactical maneuvers held in the North Sea convinced the British Admiralty that the system of using destroyers in large flotillas of twelve to twenty boats necessitated the building of special leaders, or flag boats, from which the commodore in command could control his flotilla just as an admiral handles a squadron or fleet of battleships from his flagship. Since the ordinary destroyer did not offer sufficient bridge room, living accommodations, and other facilities for the commodore and his staff, it was considered necessary to design a vessel of larger dimensions, fitted up as a miniature flagship, and possessing superior qualities of speed and armament. The pioneer vessel of this type was the "Swift," ordered from Cammell-Lairds of Birkenhead, in 1906. She displaced 1,825 tons, was 353 feet in length and 34½ feet broad, and was equipped with turbine machinery of 30,000 S.H.P. to produce the then phenomenal speed of 35 knots, which was at least five knots more than the best British destroyer of the period could make. The trials of this vessel, which was launched in 1907, were watched with keen interest, as few engineers believed she would ever make her contract speed. But the first runs over the measured mile confounded the skeptics, for the best run at full power gave a maximum velocity of 38.3 knots—a world's record which remained unbroken for ten years. Her boilers were exclusively oil-fired, and the success of this innovation encouraged the British Admiralty to embody the liquid fuel system in their later destroyers. But this drawback to the "Swift" was her inordinate cost—£280,500 ($1,402,500 at normal rate of exchange). For this sum three destroyers of ordinary type could be built, and consequently no further leaders were built until 1913, in which year the "Marksman" and "Lightfoot" were laid down. The "Swift" performed most valuable service during the war, and her dashing exploit in April, 1917, when, in company with the "Broke," she fell upon six German destroyers in the Dover Strait and routed them with heavy loss, will long be remembered. Shortly before that action her original armament of four 4-inch rapid-fire guns had been changed to one 6-inch and two 4-inch, so that she was a most formidable opponent for any destroyer. Various structural modifications have now brought her displacement up to 2,207 tons, but she is still good for 35 knots.

The value of the flotilla leader is evidenced by the fact that during the war period every naval belligerent, with the exception of the United States, built many vessels of this type. Great Britain added no less than 34 of them to her fleet; Germany laid down flotilla leaders of unprecedented size and power; and both Italy and Japan evolved some very striking designs. The new French naval program includes six 2,000-ton leaders, and the U. S. Navy Department is known to have prepared plans for vessels of the same type, though their construction has still to be authorized.

The accompanying table shows at a glance the principal features of representative flotilla leaders built, building, and projected for the world's navies.

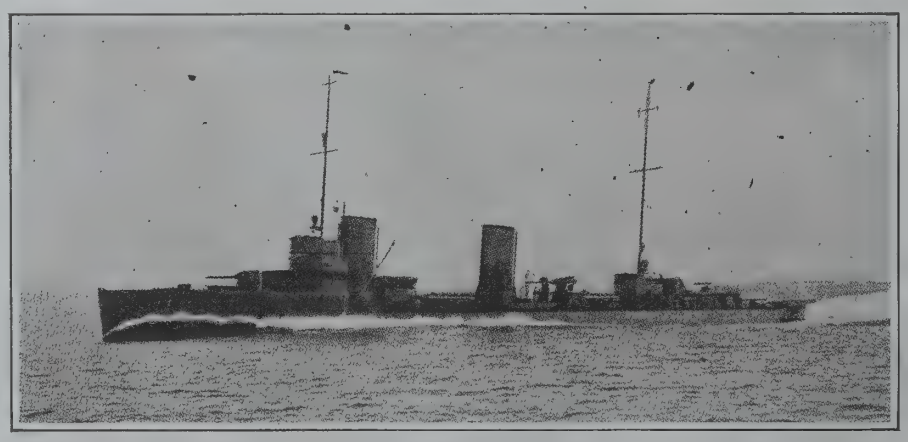
It will be seen from the accompanying list that the German flotilla leaders easily surpassed their contemporaries in size and weight of armament. These twelve boats—"S-113-115," "V-116-118," "G-119-121," "B-122-124"—were designed to form an "Iron Division," primarily for the purpose of defending the "Heligoland Bight" against British raiders and mine-layers. They are of peculiar interest, illustrating as they do the radical change induced in the German conception of destroyer functions as the result of war experience. Before the war German naval officers attached minor importance to the gun armament of their torpedo craft. Logically enough, they insisted that the torpedo was the only weapon that counted in this type, and that every ton of available weight must be devoted to speed and torpedo tubes. It was not until a whole series of their boats had been sunk or badly mauled by the heavier gunfire of British destroyers that they departed from this rigid principle. All the German pre-war boats mounted 3.4-inch 22-pounder guns, which were soon replaced by the 4.1-inch 38-pounder with a semi-automatic breech-block, enabling a very high rate of fire to be maintained. Guns of this caliber were supplied to nearly all the boats built during the war, and proved superior in range and smashing power to the British 4-inch. But it cannot be said that the German destroyers ever took kindly to artillery duels, and to the end of the war they never used their guns to full advantage.

What the big super-leaders of the "V-116" class might have done can only be surmised, for none of them was commissioned in time to take an active part in the war. A great mystery has been made in Germany about these twelve boats and the details of them given in the above list have not previously been published. Five boats were completed in the spring of 1918 and ran their trials in the Baltic. Most of them exceeded the designed speed of 35 knots, but the great weight of armament and the immensely powerful machinery proved too much for the scantlings, and all five had to go into dockyard for extensive alterations, which were still incomplete at the date of the armistice. The four 5.9-inch guns were on high-angle mounts and could be used either for flat trajectory fire or against aircraft. The projectile weighed 101 pounds and contained an exceptionally powerful bursting charge, which would have proved most effective against such comparatively flimsy targets as destroyers. The torpedo armament was limited to four tubes, mounted in pairs amidships, but these fired the new 23.6-inch torpedo, which is the most powerful weapon of its kind in existence. Its warhead is charged with 616 pounds of T.N.T.—practically double the quantity of explosive carried in pre-war torpedoes—and it can travel a distance of 16,350 yards at a velocity of 28 knots. Since it would be impossible to manipulate torpedoes and tubes of this size by hand, the "V-116" and her sister boats had special motors for loading and training the tubes. They were also fitted with the latest appliances for controlling

(*Continued on page 482*)

*Typical Flotilla Leaders of the Leading Navies at a Glance*

| | *British* | | *German* | *Japanese* | *Italian* | |
|---|---|---|---|---|---|---|
| | GRENVILLE | WALLACE | V-116 | AKIKAZE | AQUILA | LEONE |
| Number of boats in class... | 6 | 12 | 12 | 5 | 4 | 4 |
| Year of launch..... | 1916 | 1918 | 1917 | 1921 | 1916 | 1920 |
| Length over all, ft..... | 325 | 329 | 360 | 350 | 315 | 360 |
| Beam, ft..... | 31¾ | 31¾ | 36 | 34 | 31 | 34 |
| Displacement, tons..... | 1,666 | 1,740 | 2,400 | 1,900 | 1,600 | 2,200 |
| Shaft horse-power..... | 36,000 | 40,000 | 55,000 | 50,000 | 44,000 | 42,000 |
| Speed, knots..... | 34 | 36 | 35 | 38 | 34 | 34 |
| Fuel capacity, (oil) tons.... | 500 | 550 | 700 | 600 | 260 | 400 |
| Armament: guns..... | 4—4 in. R. F. | 5—4.7 in. R.F. | 4—5.9 in. R.F. | 4 (or 5) 5—5 in. R. F. | 3—6 in. R. F. | 8—4.7 in. R.F. |
| Torpedo Tubes..... | 4—21 in. | 6—21 in. | 4—23.6 in. | 6—21 in. | 4—18 in. | 6—18 in. |



**German flotilla leader "V-116," of 2,400 tons, completed 1918. Speed, 35 knots for 55,000 horse-power. Armament: four 5.9-inch, one 3.4-inch (anti-aircraft); four 23.6-inch torpedoes**

## Golf Without a Caddy

**By Elmer A. Sperry**

GOLFERS are being made faster than caddies. Nature apparently has little to do with the former, while we are compelled to leave it very much in control of the latter. It is more and more difficult to get caddies and those who do get them find them of little account. Some seasoned golfers absolutely refuse to carry their own bag over the course. No matter how experienced they may be, they are probably far wiser than they know; there is a decidedly startling and quite unsuspected reason why caddiless golf is exhausting. An analysis of the underlying causes is of more than ordinary interest.

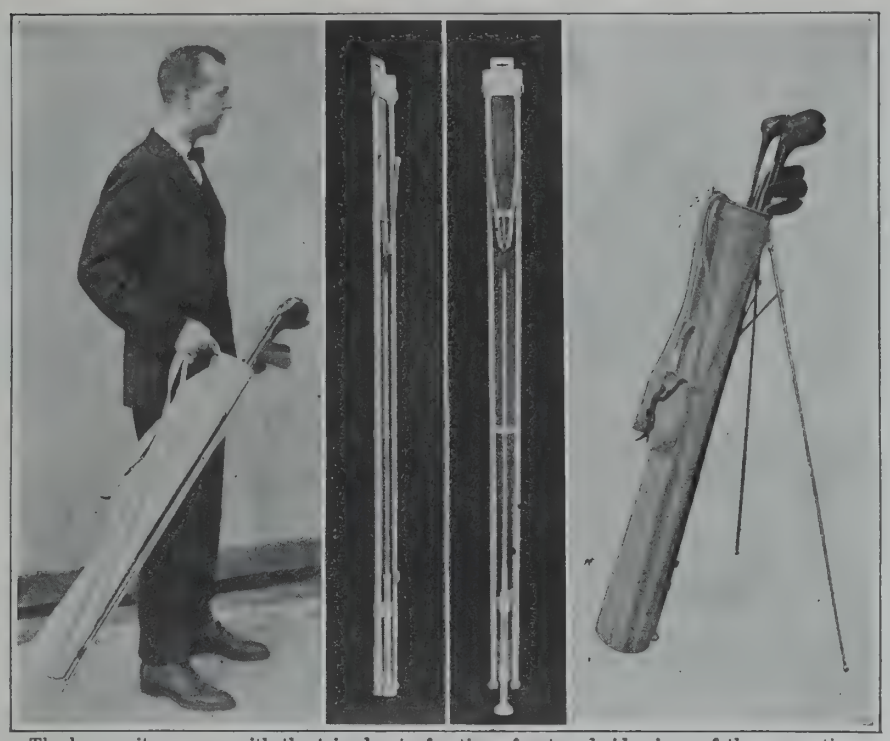
Everyone knows that he gets tired in toting his own golf bag, much more so than seems at all reasonable. An abundant reason for this fatigue is revealed, however, in the *dynamics* of the proposition, which involves elements heretofore neglected. Analysis reveals the fact that it isn't toting the bag that makes one tired; in fact, we are quite familiar with the energies that this factor involves. It probably requires, in the great economics of nature, about 30 watt-hours per ton-mile to cover this part of the work. This means, where a player averages 2½ miles an hour, 2½ times 30, or 75 watt-hours to be multiplied by the tonnage of the bag, which equals roughly 1/200. This equals 100/266 or for two hours a total of 200/266 watt hours, which, being interpreted, means about the power required to raise about one ton through the distance of one foot or about one foot-ton of energy. This may seem staggering, but it is quite an unimportant factor as compared with one other of much greater magnitude, and it is this latter which really saps the energy of the player, namely, picking up his bag and its constant repetition. This tires him far more than has been supposed, actually over 24 times as much as toting the bag.

In lifting, it isn't the bag that weighs, but the *man*. We have lost sight of the player's own weight which is involved in this process. Suppose the player's center of gravity is lowered 2 feet at each pick-up and raised again, and his weight is 150 pounds. He thus exerts 300 foot-pounds of energy in lifting his own weight regardless of any other factor. Again the muscular energy involved in lowering himself is understood very well and is about ¼ of the above amount, or 75 foot-pounds. Again another quantity occurs in the small amount of stooping and rising again in the act of lowering the bag to the ground before making his shot. No player drops his bag any great distance—the clubs are too valuable for this. This factor averages about 85 foot-pounds. He of course also lifts the bag itself, say 10 pounds, through three feet, giving 30 foot-pounds additional for this item. Let us now add these items and see what it amount to—300 plus 75 plus 85 plus 30 equals 490 foot-pounds. Now let us suppose the course is an average hard course and our average player requires 100 strokes to go around; he will use up no less than 49,000 foot-pounds of energy or the amazing effort of 24½ foot-tons—more if he is a tall man, again more if he weighs in excess of 150 pounds, and doubly more if he is both, as many men are. And this in only one round. No wonder the player feels himself "all in" in toting his own bag in the old way. Here is an enormous store of energy that should be conserved for the game itself instead of being utterly and uselessly wasted—and what a waste! The kind that causes exasperating delays upsetting one's own game, and what is most exasperating, often that of many others as well.

Practically all of these 24-odd foot-tons of energy per man per round can easily be saved by the simple expedient of an upstanding or stabilized bag. Put a spike in the bottom of your bag and drive it into the turf. Do anything rather than drop your sticks. Personally, I was appalled at the results of these simple calculations. Accurate information as to the real seat of a difficulty allows us to engineer around it, in fact, in this case to avoid it entirely. In my own case it is very gratifying to know the real reason for "that tired feeling" after caddiless golf and to find it not wholly due to advancing years after all. I am happy to say that I have experienced complete relief from the extra fatigue, finishing a round fresh and ready for more, by employing this simple device of the upstanding, stable bag.

In my case I have been able to accomplish this by a little attachment which I designed for my light "Sunday" bag. It weighs only a few ounces and can be readily attached or detached. This was made by my boys at the works, who seem to take extra pride in providing the boss with an energy-saving device. This

(*Continued on page 482*)



The bag as it appears with the tripod out of action; front and side views of the supporting members; and the way in which the bag stands "on its toes"

**Mr. Sperry's up-standing golf bag that saves the caddiless player 25 foot-tons of energy per round**

## Keeping in Step

**By Ralph Howard**

THE latest departure in synchronous motor application is the installation of a very small self-starting motor in a clock, where it is used, in connection with a high grade clock movement, to compare the speed of a synchronous generator with exact time, in order to give a continuous check on generator frequency. Since any change in the speed of the generator is reflected in the speed of this small motor, whereas the clock speed remains constant, the combination forms an accurate method of maintaining constant average frequency.

These small motors can also be used on the system in place of clock mechanisms to drive graphic recording instruments, demand meters and time switches. By the use of this motor the synchronization of records from graphic meters and demand meters will be made possible; something that has always been desirable, but somewhat difficult of accomplishment heretofore.

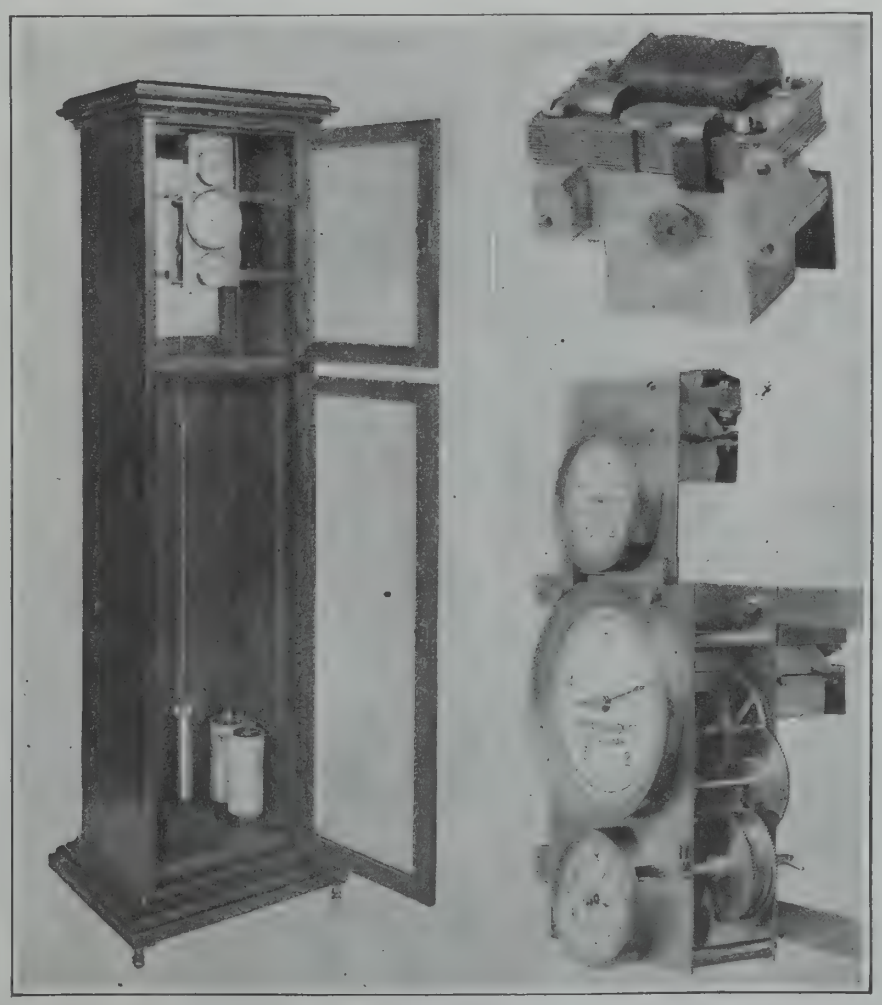
In practice, a master clock containing two movements, one electrical, and one pendulum-operated, is located near the switchboard. The face is equipped with two pointers, one black, the other gold, rotating independently about the same center, on a dial, called the operating dial. The black pointer is so geared to the pendulum clock, as to make one complete revolution every five minutes. The gold pointer is geared to the small synchronous motor, so that when the frequency is correct it will rotate at the same speed as the black hand. All that the operator has to do is to hold the two pointers together—he will then have a fixed relation maintained between standard time, and generator speed, or cycles and time. This can be done by adjusting the speed governors of the prime movers. The master clock does not obviate the use of a frequency meter, or indicator, since it will not show instantaneous fluctuations in speed. Moreover, by using a frequency indicator near the master clock, the latter may be used as a constant check on the accuracy of the former.

The little synchronous motor which is the vital part of the electric component of the clock is only 2⅛ by 2⅝ by 2 9/16 inches in size, and is wound for operation on a 110-volt circuit. It consumes less than 4 watts at 110 volts, 60 cycles, but can be made for any one of the standard commercial frequencies. It is self-starting under load, reaches synchronous speed in less than a second and holds speed as long as the current is uninterrupted. It is simple in construction, and since its gearing runs permanently immersed in oil it requires but little attention to keep it functioning properly for an indefinite period.

There have been developed two forms of master clock, known as the type "A" and type "B." The principal difference in operation of these two is that in the "B" type, both the motor and the clock mechanism act on the same index hand, through gearing, so that the synchronous motor tends to drive the hand in one direction, while the clock mechanism tends to drive it in the opposite direction.

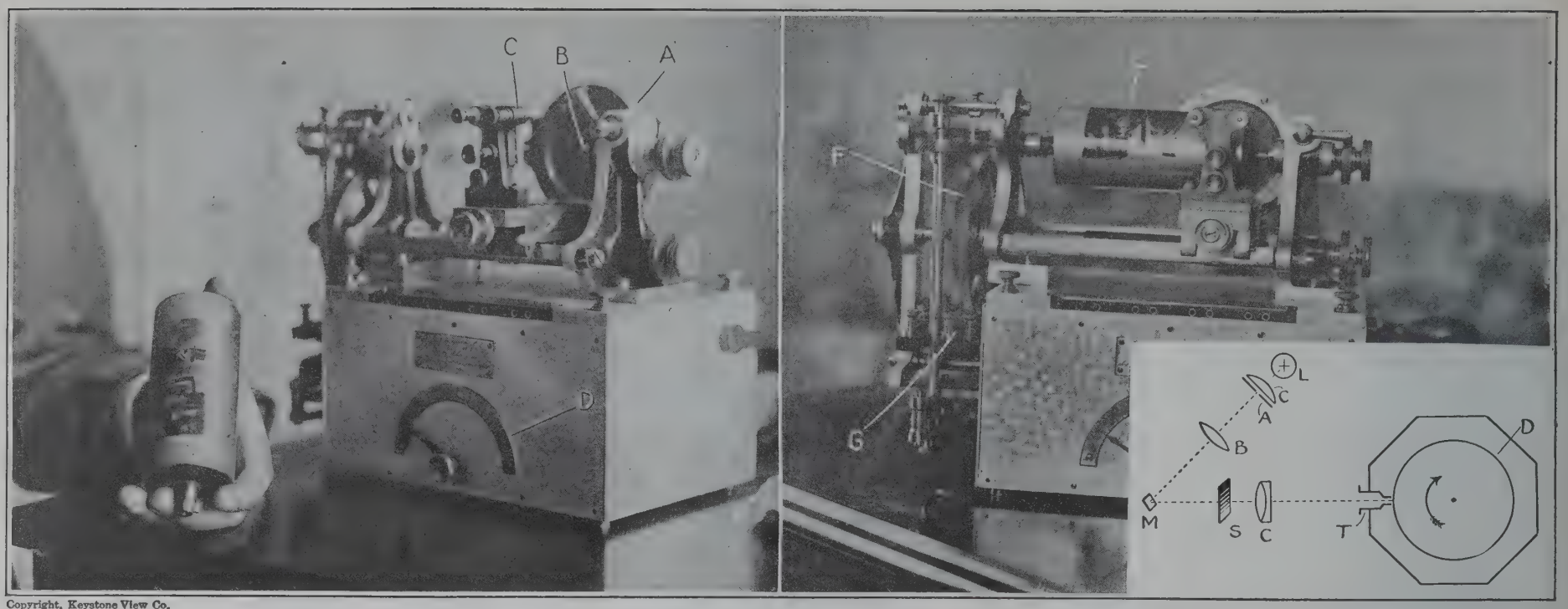
If the rate of the clock and motor are the same the hand rests at zero on the scale, but if the speed of the motor varies the hand is moved slowly in a clockwise or counter clockwise direction according to whether the variation is a gain or loss in speed. In this way the clock is caused to indicate variations in average frequency. The "A" type is that first described, in which control of the two speeds comes from comparison of two hands.

The installation of these master clocks will not eliminate fluctuations which are dependent to some degree on load variations, speed governor response, or steam pressure — features of operation which are more or less constantly encountered; but it does insure the maintenance of a more uniform as well as correct average frequency.



*Left:* Front view of the master clock. *Upper right:* The motor for the master clock. *Lower right:* Movement of the master clock

**The motor-controlled synchronizing clock**




Copyright, Keystone View Co.

**Two views of the transmitting device for sending photographs, manuscript, drawings, and printed matter over wires and (in the insert) the method employed for translating the modulated current back into a copy of the original at the receiving end**

# Sending Photographs Over Wires

## Details of the Belin System To Be Tried Between St. Louis and New York

By Austin C. Lescarboura

THE important happening in Shanghai is printed in the New York newspapers the following morning. Indeed, so remarkable is our news-gathering machinery of today that half the world knows precisely what the other half is doing by the telegraphed or cabled or via radio word. And in due course the first half receives photographs of the happening in the second half of the world, thus completing the account; for if there is one thing certain in modern journalism, it is that photographs tell a story incomparably better and more readily than the best word picture.

Now, then, were it possible to transmit the story and the photographs simultaneously, our news-gathering machinery would be nearly perfect. Many a fine photograph must needs be discarded for the reason that it arrives too late to be of interest to the readers of large metropolitan newspapers. There is a tremendous wastage in this direction, due to the weeks and even months which must elapse in transmission.

With the urgent need for a rapid means of transmitting photographs before us, we can turn to the efforts of M. Edouard Belin of Paris, France, with a greater sense of appreciation. M. Belin has been working on the problem of transmitting photographs over wires since 1907. After certain changes in his basic designs as well as constant refinement in all the details, he has finally achieved noteworthy results for his latest system. In fact, he has to his credit the transmission of photographs over telegraph lines between Paris and Lyons, Paris and Bordeaux, Paris and Nice, Paris and London, and Paris and Antwerp.

At present M. Belin and his assistants are in the United States for the purpose of demonstrating the telestereograph, as it is called, over long-distance lines. The first test is to be between St. Louis and New York, and is being conducted under the auspices of the *St. Louis Post-Dispatch* and the *New York World*. It may be that M. Belin will later attempt the transmission of photographs between New York and San Francisco; but at any rate, he has come to this country of vast distances in order to put his system to the acid test, so to speak.

The first attempts at telegraphic transmission of autographical texts go back to the work of Abbé Caselli in 1860 and the device known as the Pantelegraph Caselli. The first attempts at the transmission of photography are attributed to the German, Professor Korn of Munich, who made use of selenium but later on, in a modified system, returned to a scheme very similar to that of Caselli. In the case of M. Belin the selenium and other delicate elements have been replaced by more practical means. The transmission is simply a matter of preparing a bas relief of the photograph, and then tracing that bas-relief with a stylus connected to a telephone transmitter. The latter varies the current flowing over the telegraph or telephone line in accordance with the relative height of any point on the bas relief record at any given moment. At the receiving end this current variation is translated into various gradations of light in the manner described further on.

The first step, then, is to prepare the transmitting record or plate. A copper cylinder forms the base of the record, and its surface is coated with a 5 per cent shellac solution. Meanwhile a carbon print is made in the conventional photographic manner from the photographic negative to be transmitted, after which the print is wrapped face to face with the shellacked copper cylinder. The cylinder with the print is then placed in hot water, with the result that the gelatine of the print adheres to the cylinder in accordance with its own degree of blackness, while the unexposed gelatine is washed away with the paper. In this manner a coating of uneven thickness is formed on the cylinder, or a photograph in bas-relief.

**Reproduction from a photograph received by M. Belin's apparatus. Note that in our half-tone reproduction considerable detail is lost**

The copper cylinder is then placed in the transmitting device which bears a close resemblance to the cylinder type phonograph. As will be noted in the two illustrations of the same transmitter at the head of this account, the components of the transmitter are: *A*—A special microphone with a stylus *B*, which is in constant contact with the face of the cylinder. *C* is another form of stylus, about which we shall have more to say further on. *D* is a speed regulator, controlling the clockwork which drives the transmitter. *E* is the copper cylinder with the photograph in bas-relief. The cylinder, it will be noted, can be inserted or removed with as much ease as the changing of cylinder records on the phonograph. *F* is a two-speed gear transmission, driving the cylinder. *G* is the synchronizer, which causes the receiver to keep in step with the transmitter by a series of electrical impulses sent over the line.

As the copper cylinder revolves, the microphone, with its stylus always in contact with the record face, is slowly moved along the record, touching practically every part of its surface. As the unevenness of the surface depresses the microphone stylus more or less, the current flowing through the microphone is modulated so as to correspond with the varying density of the photograph.

The receiving end must translate these electrical variations back into the original photographic terms. This it does in the manner indicated in the line drawing which forms the insert of the two illustrations at the head of this account. First of all, we have a special form of diminutive arc light shown at *L*, which sends its rays through the condenser *C* and the aperture *A* and again through the lens *B* on to a tiny mirror *M*. The mirror is mounted on the twin wires of a Blondel oscillograph—an apparatus with powerful electro-magnets and a pair of silver wires which carry the oscillating mirror, located in the powerful magnetic field. The Blondel oscillograph is a highly sensitive apparatus, and the immersion of the wires in thick oil causes the action to be practically "dead beat," or, to put it in another way, the wires have little momentum. As the current of varying intensity comes over the wires to the receiving set, the wires of the Blondel oscillograph cause the tiny mirror to turn more or less on its axis. However, no matter how far the mirror may turn, its reflected beam still passes through the screen *S*, the lens *C*, the almost microscopic aperture at *T* and on to the sensitized surface on the cylinder *D*.

The whole crux of this apparatus is the screen *S*, which is a screen of varying transparency. That is to

(*Continued on page 483*)

## From Coal Barge to Ship's Bunker

A COAL barge with an elevator and chute has made its appearance in San Francisco Bay and has as a purpose the direct coaling of a ship while the cargo is being unloaded, obviating the necessity of the ship's proceeding to a bunker wharf to receive its fuel. Instead of the usual clam-shell bucket, such as is used at bunker wharves, the coal is sent up on an elevator and slides down a chute into the ship. A donkey engine on board operates the elevator.

**This coal barge delivers its coal directly to the ship by means of an elevator and chute**

## Converting Steel Back Into Iron

CONSIDERABLE has been said and written about making steel in the electric furnace, which is a development of the last four years. Not so much has been promulgated about making pig iron from steel in such a furnace. It is standard practice to make pig iron, from which all steel is originally made, by smelting iron ore in a blast furnace and thus reducing or converting it to metallic iron, so-called, in the shape of pig iron.

A new and unique method has recently been developed however for converting scrap or old steel *back* into pig iron. Why this is done or even is necessary needs explanation first. At times certain kinds of pig iron are hard to obtain as made by standard methods. This has been true lately in Canada and France. It was therefore necessary to make it by a new method if possible.

The illustration shows how this was and is done in France. It represents a French electric furnace for converting scrap steel back into pig iron, something never thought possible nor probable only two or three years ago. Scrap steel or borings or turnings are charged from the upper flat form into the top of the furnace shown. Electricity is conducted into this furnace by the apparatus suspended from the wall. When the crude steel is melted certain additions are made to it so as to increase the percentage of carbon, silicon, etc., and very soon after the mass is tapped out at the bottom, as shown, in the shape of pig iron. It can be seen flowing into systematic molds made in a bed of sand. When cold it is removed and is called "pig" iron because each section of iron is attached to the central larger section or trough much as pigs gain their sustenance from the mother sow.

Many tons of such iron has been made in both France and Canada and it is regarded as, or can be made, the finest pig iron of any.

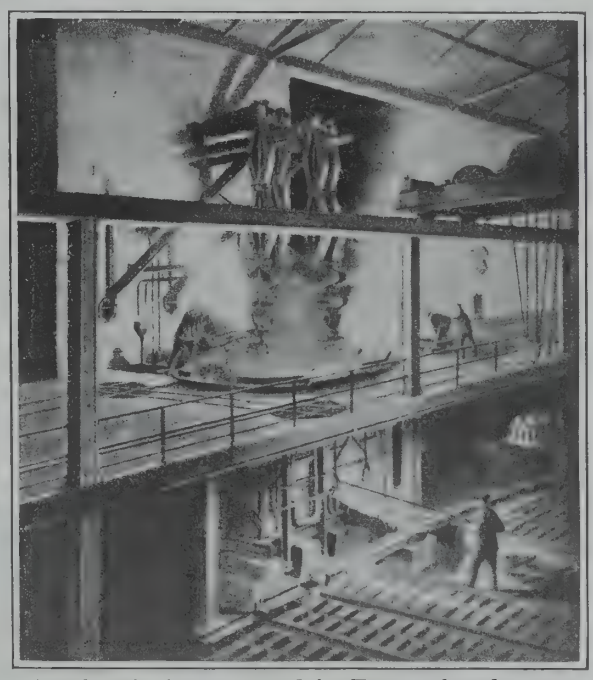
## The Motorcycle's Future

NOW that the former British and German motorcar owner has to be content with the more modest motorcycle, we may look for a considerable development along the lines of general utility and cheapness, says a writer in a British technical review.

Before the war the tendency of the motorcycle, under American influence, was towards increased weight and horse-power, and consequent complexity. Now, however, the chief considerations are safety, lightness, and simplicity to meet the requirements of the average man, who wants a cycle that will start up without causing him undue exertion, that can be lifted up and down steps and is not prohibitive in price or upkeep.

The lines on which improvements should proceed are, above all, toward simplification and comfort. The belt drive, a fruitful cause of breakdown, must be eliminated, the various parts simplified and their number reduced, the lighting system should be made as elementary as possible, and all complicated control on the handle-bars suppressed. Special care must be given to the brakes and the saddle should be made adjustable to the rider's comfort.

Another paramount necessity is that wheels should be made easily removable, in view of rendering the repair of punctured tires as simple a matter as possible, and there is plenty of scope for improvement in the tires themselves. High speed is not required, therefore the engine can and should be as light as is compatible with reliability. The development of the motorcycle as the plain man's vehicle also promises a future for the autowheel and motorscooter.



**An electric furnace used in France for the purpose of converting scrap steel back into pig iron**

## Shall We Wear Paper Clothes?

BEFORE we part with a good share of our yearly income for a serge or woolen suit, it may be a matter of real wisdom to look into the paper clothes situation. At any rate, the Bureau of Foreign and Domestic Commerce has on exhibition a large assortment of Austrian paper clothing and associated paper articles collected for the information of the American clothing and other interested industries. The exhibit includes workmen's suits, table covers, collar and cuffs, laundry bag, wall decoration, twine and other articles.

In this interesting collection there is a suit made of 40 per cent paper, which sells in Austria for 575 crowns, or about $2.65 in American money at the present rate of exchange. A workman's all-paper suit in brown is quoted at 32 crowns, or about 15 cents in American money. A blue all-paper suit is more expensive, 120 crowns (about 55 cents) being the asking price.

The report which accompanies the paper samples states that the garments are really washable, cold water, soap, and a scrubbing brush being the proper means. It is also reported that during the past year Austrian paper goods manufacturers have exported large quantities of their output to Italy and to Turkey. A previous report spoke of about 40,000 German paper suits being on display in a store on the Strand, London. After a brief stay in the Bureau of Foreign and Domestic Commerce, the paper articles will be offered to clothing and other interested manufacturers for examination.

Copyright, Underwood & Underwood

**Austrian suits for workmen, a damask luncheon cloth and a laundry bag—all made of paper**

## A Grass Lawn Like a Carpet

IT is proverbially a slow business getting a good grass lawn in a garden, but a new English idea makes it possible to secure a fine stretch of verdure just as one would buy a carpet at the stores. Grass seed is sown thickly on strong canvas and, when this is thickly covered with growth it is ready for making the lawn. The site is well prepared, being made perfectly level and special attention is given to getting the soil so that it is a favorable rooting medium for the little plants. Then the grass mats are put down on sections, these being closely fitted together. As time goes on the roots push down through the canvas and, in this way, establish a permanent lawn. Ultimately the material will rot. The value of this plan lies in the fact that an immediate effect can be secured. It is quite easy to have a splendid grass lawn in a situation where, a few hours before, there was nothing of the kind. From thenceforward the grass will go on improving and the little plants speedily take a hold on the soil.

## A New Kind of Coal

HERE is a new suggestion as to fuel—a new kind of coal. It is especially timely with coal at the high prices at present obtaining. The idea comes from Norway and is the result of experiments carried out in a plant at Greaker, Norway, where an improved process has been employed to produce sulfite coal as a by-product from the manufacture of wood pulp.

A ton of wood pulp yields 9 to 10 cubic meters of sulfite lye, of which 95 per cent is available for the production of coal, compared with about 60 per cent from other processes. If the new process is generally adopted it is estimated that it will be possible to produce annually sulfite coal equivalent to 800,000 tons of imported coal.

Considerable quantities of cheap alcohol are produced from the wood pulp lye before it is made into coal. An essential feature of the new process is high concentration of the lye before removal from the autoclaves. By concentrating it to 30 per cent not only is a high percentage of coal-producing substance obtained, but the quantity of solid matter is increased by 50 and even 70 per cent.

## A Fountain for the Cows

THE average dairy cow drinks anywhere from 60 to 100 pounds or more of water daily—in fact unless she gets plenty to drink, her milk yield will be visibly reduced. That is why dairy farmers devote particular attention to equipping their farms with all the modern facilities—somewhat in the nature of dairy cow soda fountains—for satisfying Bossie's thirst.

One eastern farm has provided durable concrete water tanks in each field where the cows are pastured. The tanks are connected directly with the farm water supply, a float being placed in each tank so that the water level is maintained at the same point all the time. Considerable trouble obtained due to the fact that the cows would nose and damage the floats so that they would not work properly. Then the owner devised the type of tank shown in the accompanying picture which provides a sort of square-shaped nub at one side of the tank for the float and the inlet and overflow pipes. An iron framework is provided over the top of the compartment so that the cows cannot reach or touch the float with their noses. Now Bossie and her mates never lack for fresh water as the dairy never runs dry.

**This concrete fountain serves fresh water to a herd of cows without attention of any kind**

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

Copyright, Kadel & Herbert

**This side car can be attached or detached in a few minutes and adds little to the weight of bicycle**

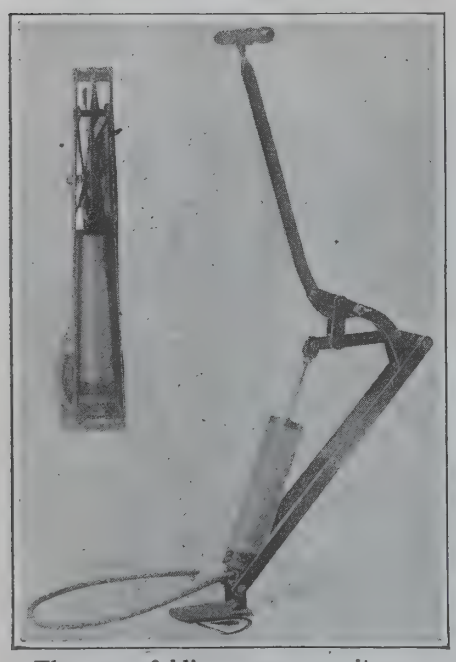
## The Bicycle with the Side-Car

THE bicycle is by no means obsolete in most European countries. Indeed, the shortage of gasoline and the economic situation as a whole have caused the European to hold on to his bicycle or even to go back to such a vehicle, while his more progressive and more fortunately situated American brother has gone on to automobiles, motorcycles, cyclecars, scooters and whatnot.

A recent European development is the side-car for bicycles, as represented by the accompanying illustration. Here is a side-car especially suited to the man who wishes to take along his child. The passenger may be up to seven years of age. The body has two large springs and ensures comfort in riding. It is provided with a windshield and a top. The body, which can be quickly attached or detached from the bicycle, adds very little weight to the latter.

## A Folding Air Pump for the Motorist

AN air pump which folds up into a small space and can be slipped into any tool box has been introduced by an Illinois manufacturer. The pump is operated on the leverage principle and it is claimed that it will force air against a pressure of over 250 pounds. Increased power and increased leverage are developed with each stroke. It is constructed of pressed steel and has no stuffing box. The only parts present in the compression chamber are a steel plunger with a heavy cup leather. Although the cylinder is quite short it is claimed that the friction is nominal and the pump has no tendency to heat. A 30 x 3 tire may be inflated to 60 pounds pressure in 60 strokes.



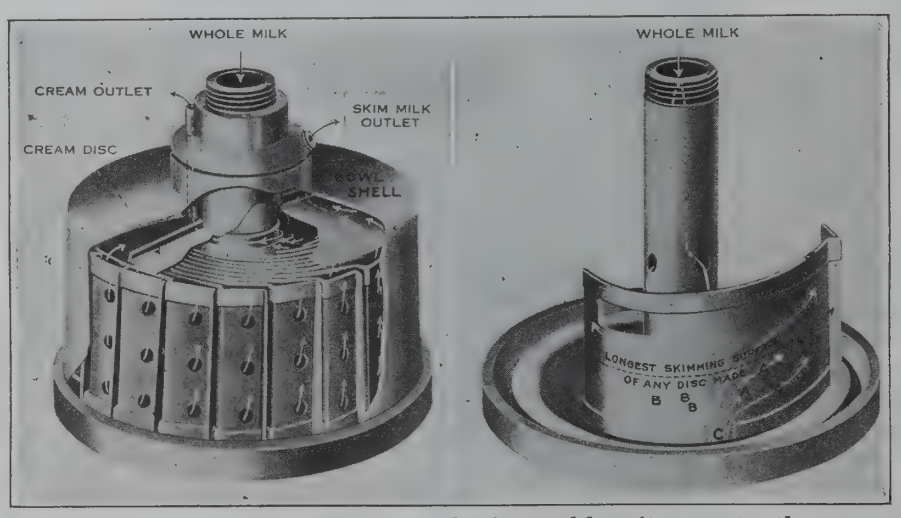
**The new folding pump as it appears complete folded and ready for use**

## Something New in Cream Separators

THE separation of cream (butter-fat) from the whole milk is due to the fact that the milk particles, being heavier in weight than the butter-fat particles, are thrown outward by the terrific centrifugal force exerted by the revolving of the bowl anywhere from 9,000 to 15,000 turns per minute.

Heretofore all disks in cream separators have been of the cone-shape design. The whole milk, flowing in at the top, has had to travel downward, between these numerous disks placed but ⅛-inch or less apart. Naturally, with this extreme velocity, and due also to the fact that both milk and butter-fat particles enter at the extreme edge of the disks, not all of the butter-fat particles can get out of the way, or, in other words, back up against this tremendous pressure, and are therefore carried along and out into the "skim-milk." This causes quite a loss of cream.

But there is now on the market what is known as the "straight disk"; the whole milk flowing first to the bottom and then entering each disk at its center, which, as shown in one of our drawings, gives the butter-fat particles *B* a chance to slip back toward the cream outlet, and out of the way of the heavier milk particles *A*, thus producing a separation that is practically 100 per cent.




**Details of the new cream separator mechanism and how it separates the cream from the milk**

## Revival of the Merchant Marine

DURING September, for the first month since the armistice, according to returns of the Bureau of Navigation, Department of Commerce, the increase in the American seagoing merchant marine owned by American shipowners has equaled and exceeded the increase in the Government-owned ships. At the last session Congress in the appropriation bills changed the war policy and directed the Shipping Board to maintain itself by sales of ships and shore property without further appropriations. During September the fleet of seagoing ships of 500 gross tons or over of American shipowners rose to 1,829, of, 4,625,324 gross tons, an increase during the month of 25 ships of 116,335 gross tons, while the Government-owned tonnage during the month increased only 20 ships of 88,855 gross tons, giving a Shipping Board total of 1,698 ships, of 7,288,208 gross tons, on October 1. Since January 1, 1920, however, the Government-owned tonnage has increased by 233 ships, of 1,347,466 gross tons, while the commercial marine of American shipowners has increased only 129 ships, of 536,926 gross tons.

## A Machine that Refinishes Floors

KEEPING any large dancing floor in first class shape is no small job, especially in the usual manual way. It has remained for inventors to produce a floor-scraping machine of the type shown in the accompanying illustration, which, driven by a powerful electric motor, travels over the floor, shaves off the old surface and smooths the new one, and then sweeps up all the shavings and dust into a bag at the rear of the machine. This machine makes the job of keeping floors in good shape relatively simple and inexpensive, particularly in these days of high labor costs.

## A Poison-Gas Gun for the Law-Abiding Citizen

THE good citizens of Paris seem to have taken the initiative in the war on criminals which must be fought in order to suppress the tidal wave of crime that has swept almost all countries since the termination of hostilities and the disbandment of large armies. It has remained for some ingenious Frenchman to produce a liquid poison-gas pistol, which is shown in the accompanying illustration.

This little instrument of protection for the law-abiding citizen has been inspired by the war. It has the advantage of putting an adversary *hors de combat* immediately, but without evil effects of any kind. The gun contains liquid poisonous gas which, if it strikes the bandit, puts him to sleep at once. Again, if it strikes the bandit in the eyes it blinds him for several days.

The handle of the gun contains the liquid poison which is compressed with the aid of a bicycle pump at the lower end of the handle. All one has to do is to point the gun at the target at a distance of not more than ten feet, and press the trigger which releases a thin stream which is accurate at that range. The liquid, emitting poisonous gases, disarms the bandit.

Copyright, Keystone View Co.

**This machine scrapes the floor and refinishes it, gathering the shavings in the bag**

## Recent Patent Decisions

**Phonograph Horns.**—This case involves a patent of a horn for phonographs, the body portion of which is composed of longitudinally arranged strips of metal provided at their edges with outwardly directed flanges whereby said strips are connected, and whereby the body portion of the horn is provided on the outside thereof with longitudinally arranged ribs, said strips being tapered from one end of said horn to the other.

The complainant in this suit seeks to restrain the defendant from making, using, or selling phonograph horns infringing its patent issued to Peter C. Nielsen. It further seeks the profit realized by the defendant, and damages. The defendant denies liability on the ground that it did not infringe under any permissible interpretation of the patent, that the claims of the patent, if not wholly invalid, are entitled to a narrow construction only by reason of prior art patents and publications and prior state of the unpatented art.

Held that the Nielsen patent is valid. A patent for a device which performs a novel and useful function, as the horn in question for phonographs which did

(*Continued on page 484*)

Copyright, Kadel & Herbert

**This pistol shoots a stream of liquid poison gas which puts a bandit hors de combat**

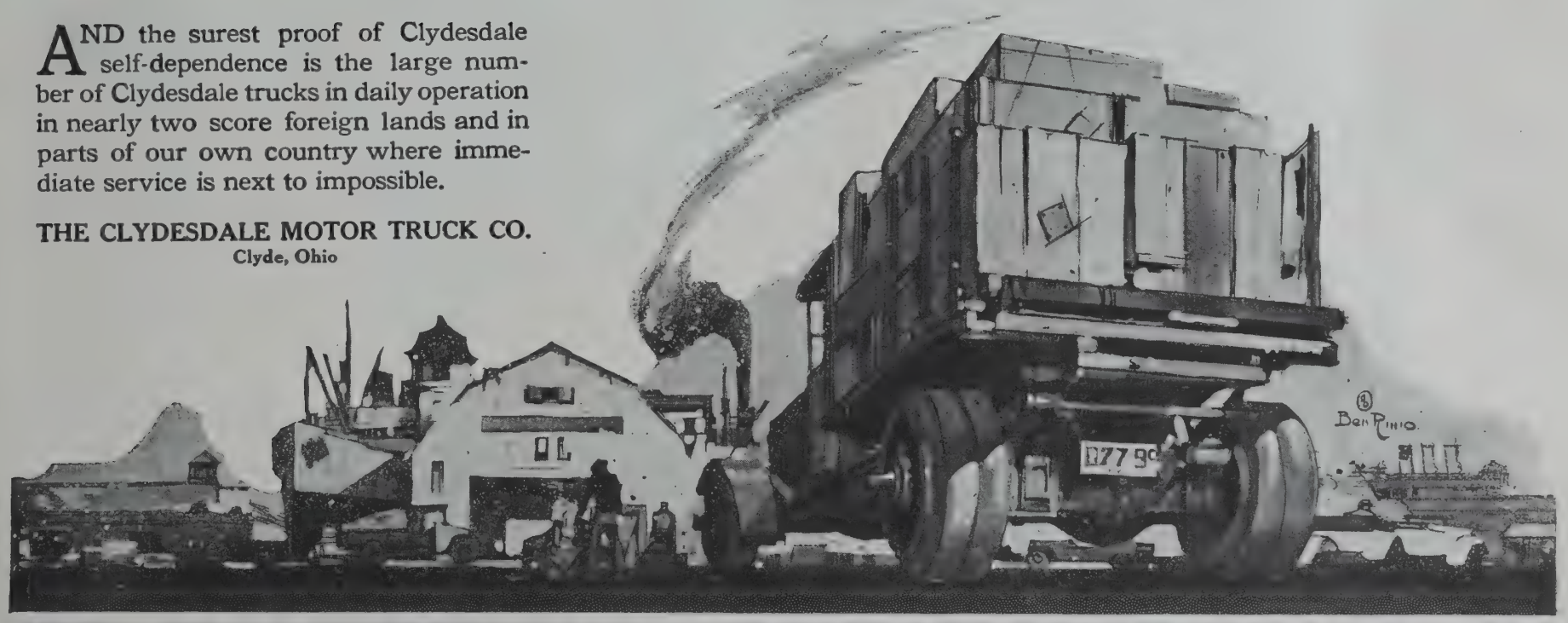
# DEPENDABILITY

## ONE TRUCK ON THE ROAD IS WORTH TWO IN THE SHOP

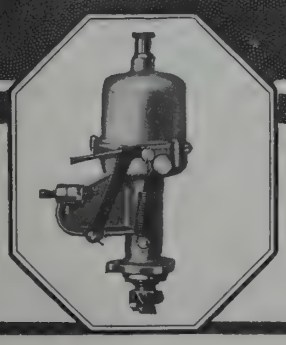
THE motor truck is only profitable if it is kept moving. To keep on the road and out of the shop, a truck must meet two important conditions: it must first be dependable in itself, and then it must be properly serviced. Dependability is paramount, though, for sometimes a truck must operate where service is not always instantly available.

AND the surest proof of Clydesdale self-dependence is the large number of Clydesdale trucks in daily operation in nearly two score foreign lands and in parts of our own country where immediate service is next to impossible.

THE CLYDESDALE MOTOR TRUCK CO.
Clyde, Ohio




# CLYDESDALE MOTOR TRUCKS



### An Added Feature of Dependability

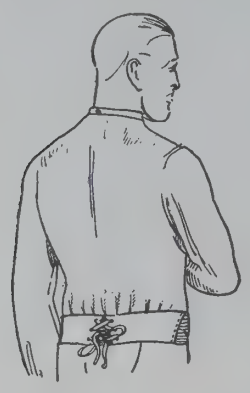
The Clydesdale Controller makes this truck reliable because it insures positive action under all conditions. By regulating the motor speed to accomplish just what is necessary, no more or no less, this automatic device prevents truck abuse.

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

## Pertaining to Apparel

SHIRT.—J. P. MULLANE, 17 Ellsworth Ave., Cambridge, Mass. Among the objects of the invention is to provide a shirt which is practically tailless and which in lieu of the ordinary



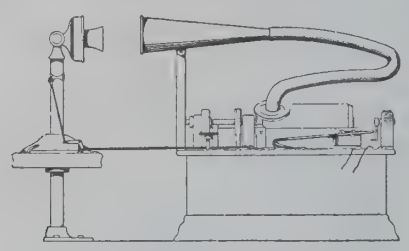
A REAR VIEW OF THE SHIRT IN USE

tails is provided with a belt which forms a part of the shirt and which fits snugly around the hips; the shirt is also provided with ventilated inserts below the arms which increase the wearing qualities, and add to the comfort of the wearer.

SLIPPER.—M. GAETO, 429 E. 127th St., New York, N. Y. This invention more particularly relates to a sole and heel construction which are adapted to be sold in combined form and have any desired upper or vamp attached. A further object is to provide slippers especially designed as bedroom slippers and the like and which will be strong and durable and easily assembled by any one of average intelligence.

## Electrical Devices

AUTOMATIC BURGLAR ALARM.—F. A. TERRY, Marshfield, Ala. The invention relates to burglar alarms comprising a telephone set and a phonograph disposed near the set, with brake mechanism for holding a switch hook



A SIDE VIEW OF THE DEVICE

in normal position, a motor, an electric circuit for operating the motor, and completing the talking circuit. An object is to provide an alarm which will send in a call for help over a telephone whenever put into operation by the opening of a window or door.

## Of Interest to Farmers

TAPPED WHEEL FOR PLANTERS.—C. L. HEATH, 2432 Cullom Ave., Chicago, Ill. The features of this invention are to provide a practical manner of actuating the seed dropping mechanism for check row corn planters which will do away with clutches, spring tension devices, friction devices, and other complicated means for effecting the desired result. This check row device may be conveniently applied to various makes of planters without materially departing from their original construction.

## Of General Interest

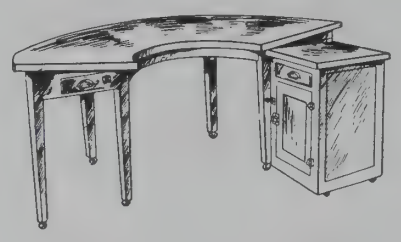
PENCIL.—H. L. BLACKMAN, c/o Parker Pen Co., Janesville, Wis. The invention pertains more particularly to that type of pencil in which a lead is fed longitudinally of the body of the pencil. It is the prime object of the invention to provide a novel form of lead-feeding mechanism and lead holder, and further to construct a pencil of this type which has the fewest number of working parts.

DEVICE FOR CONSERVING CORD AND TWINE.—O. A. GALE, Eaton, Ohio. The invention relates to means for conserving cord of odd lengths, especially in connection with post office and like work. An object is to provide a movable rack which has a plurality of spring clips, into which odd lengths of cord or twine may be sprung temporarily so that they may be within reach for reuse, thereby avoiding the waste of much material.

GAS SCREEN.—T. A. BROOKS, Newton, Kan. The object of the invention is to provide a device adapted for use in connection with gas burners, for spreading and intensifying the flame. The screen may be used on any kind of stove in the ordinary manner except when gas pressure is extremely low. Then the vessel can be placed on the lugs of the screen.

SPOOL.—A. H. SCHLOERB, 94 W. 104th St., New York, N. Y. The invention relates to spools or winding cores upon which silk thread, yarn or other products of thread manufacturers may be wound or spun. It is an object to provide a simplified form of spool construction of paper or other very light weight material which will be cheap to manufacture and which will enable the thread manufacturer to inexpensively place silk thread upon the market.

BOOKKEEPER'S WORK TABLE.—B. P. BEESON, 23 So. Park St., Box 185, Sapulpa, Okla. The object of the invention is to provide means whereby accountants and book-



A PERSPECTIVE VIEW OF THE INVENTION AS IN USE

keepers can have their books within convenient reach without leaving their seat. Another object is to provide a device wherein the various books can be kept convenient for use, and in which the books can be stored and then transferred to a safe or vault.

POWER-OPERATED RAZOR.—W. A. FUSCH, 129 Merchant St., Decatur, Ill. Among the objects of the invention are to provide a razor which will simplify and shorten the usual process of shaving which will dispense with the necessity of lathering the face, which will not require the usual keen cutting edge, which is self-sharpening to a considerable extent, and which will cut the hairs in proper and close manner without injury to the skin, and will leave the skin in a healthy condition.

COURSE FINDER.—C. N. WESTWOOD, 1015 Princess Ave., Victoria, B. C., Canada. The invention has for its object to provide an instrument by means of which courses may be easily found and corrected. The device comprises a blade, a mariner's compass card mounted to rotate on the blade, a fixed indicator on the blade coöperating with the compass card, and an arc-shaped bar adjustable transversely of the blade and carrying indicators at its ends coöperating with the card.

MEANS EMPLOYED IN PRODUCTION AND MATERIAL CONTROL SYSTEM.—E. H. BICKLEY, c/o Bickley Mfg. Co., 1033 Chestnut St., Philadelphia, Pa. This invention relates to a chart for use in connection with a system for the control of production and material in a factory, although not necessarily limited to this use as it can be applicable to wholesale houses or other mercantile requirements. The system is so flexible that it will control and can easily be adapted to any kind of factory, regardless of the nature of the product.

FLASH LIGHT BAG.—G. A. LEY, 1627 Carmen Ave., Chicago, Ill. The invention relates to photographic apparatus. An object is to provide a flash bag including a supporting staff running from the crown of the bag to the lower ends of the bottom ribs inside of the bag, thereby keeping the flash which is created in the flash pan supported by the staff, a safe distance from the bag. A further object is to provide means for employing the smoke by a flap falling back automatically to uncover an opening when the bag is turned over.

FIRE FIGHTING APPARATUS. — J. C. WITT, 300 Main St., Pine Bluff, Ark. An object of the invention is to provide a portable and collapsible fire shield to be used adjunctively with the usual fire fighting apparatus, the shield being controlled in its erection and collapse by the telescopic action of the truck upon which it is mounted. Another object is to provide fire curtains at the sides of the supporting truck, with engine driven gear connections controlled by the operator, for raising and lowering the curtains to protect the working parts beneath the truck.

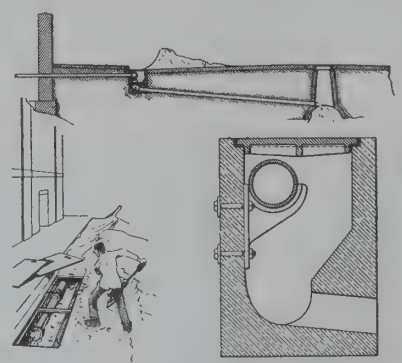
## Hardware and Tools

PACKING AUGER.—O. R. HYLAND, Box 680, Astoria, Ore. The object of this invention is to provide an auger especially adapted for packing comminuted substances in bags, as, for instance, flour and the like, wherein the arrangement is such that when the bag is filled with the required weight the vanes of the auger will be automatically thrown out of packing position into a position to check the further flow of matter to be packed.

## Heating and Lighting

FURNACE GRATE.—M. T. DAVIS, JR., Box 1244, Charleston, W. Va. An object of the invention is to provide a sectional grate for furnaces, provision being made in each of the sections for the circulation of water so that the heating area of the furnace is greatly increased. The sections consist of vertical hollow rear branches, and forwardly and upwardly inclining bottom branches, nipples securing the various sections together and affording water communication there between.

SNOW REMOVAL AND STEAM HEATING SYSTEM.—W. F. GUERIN, 1914 69th St., Brooklyn, N. Y. This invention relates to means for the removal of snow and has reference more particularly to a snow removal and steam heating system, which includes a steam



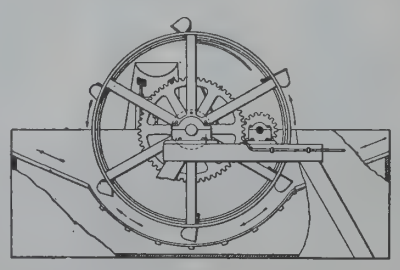
SHOWING THE ARRANGEMENT OF THE SYSTEM WITH RESPECT TO A STREET

pipe located adjacent the points where the snow accumulates, the steam pipes being adapted to melt the snow and cause the resulting water to flow away. An object is to provide means for quickly freeing streets and side walks of heavy snow falls.

## Machines and Mechanical Devices

ROAD SCRAPER.—C. M. DICUS, Gaffney, S. C. This invention relates to road scrapers of the type suitable for use upon country roads and of such form that it may be readily operated at a comparatively low cost. The scraper is a comparatively simple machine and can be pulled by horses or by a gasoline tractor and can be operated by one man.

SAND SEPARATING APPARATUS.—H. L. HAMILTON, c/o Iowa White Co., 1719 Grand Ave., Des Moines, Iowa. The invention relates to apparatus used in gravel and sand washing plants. The object is to provide a sand separating apparatus arranged to effec-



A REAR SIDE ELEVATION, WITH PARTS SHOWN IN SECTION

tively separate the same from the water without loss of even the finest sand. A further object is to provide an apparatus capable of a large output in a comparaitvely short time and without unduly increasing the operating expense.

## Musical Devices

TAMBOURINE.—I. LEVY, c/o Michthauser & Levy, Java, Provost and Kent Sts., Brooklyn, N. Y. The primary objects of this invention are to so construct a tambourine as to materially reduce the cost of manufacture, and to render the same more durable than tambourines as usually constructed. The instrument comprises an integral flange defining one edge of the main body, and provided with a plurality of cut-out portions, and sound-producing elements mounted in the cut-out portions.

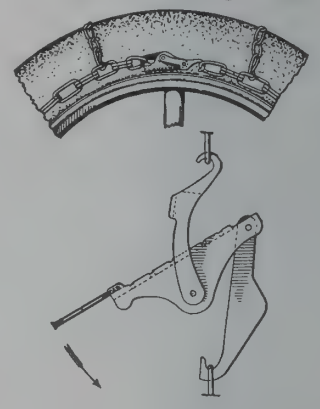
## Prime Movers and Their Accessories

AUTOMATIC FUEL MIXTURE REGULATOR.—A. A. LOETSCHER, Hotel Carlin, Billings, Mont. The invention relates more particularly to an automatic fuel feed regulator for internal combustion engines. An object is to provide an automatic fuel mixture regulator under the control of and responsive to the speed of the engine to effectively vary the proportion of the hydrocarbon or other combustible and of the air whereby the fuel mixture or charge delivered to the cylinders is accurately proportioned for perfect combustion and maximum power at all engine speeds.

BOILER.—J. P. PERRY, Glencoe, N. Y. An object of the invention is to provide a steam boiler design which will have a great deal of heating surface and which will be comparatively small in size, in order to provide a suitable boiler for use on airplanes, automobiles, and other vehicles, and which will also find a use in any capacity where it is necessary to produce steam for operating steam engines and turbines.

## Pertaining to Vehicles

CHAIN CLAMP AND TIGHTENER.—G. J. WIEDMAN and J. H. HUGHES, 202 Mont Bldg., Lewiston, Mont. This invention has for its object to provide a chain clamp and tightener, especially adapted for securing non-skid chains



A SIDE VIEW OF CLAMP PARTLY OPEN, AND CHAIN CLAMPED ON TIRE

on motor vehicle tires, wherein mechanism is provided for easily and quickly tightening the chain and clamp in place beyond the possibility of accidental opening.

BRAKE ATTACHMENT FOR AUTOMOBILES.—H. W. HAAPANEN, 224½ St. Jean St., Detroit, Mich. Among the objects of the invention is to provide a device having elements or shoes which engage with the road bed, for positively stopping the automobile or preventing skidding, and which may also serve as a supporting means to retain the tires elevated from contact with the bed when the machine is not in use.

BASE FOR JACKS.—A. E. HUTCHISON and H. KRAH, 372 Monroe St. Brooklyn, N. Y. This invention pertains more particularly to lifting jacks especially employed as an accessory of motor vehicles. In jacks of this type difficulty has been experienced in maintaining the jack in true vertical alinement during the lifting operation. In this device a rigid base is provided, capable of removal, and with securing means which may be adjusted with respect to the base.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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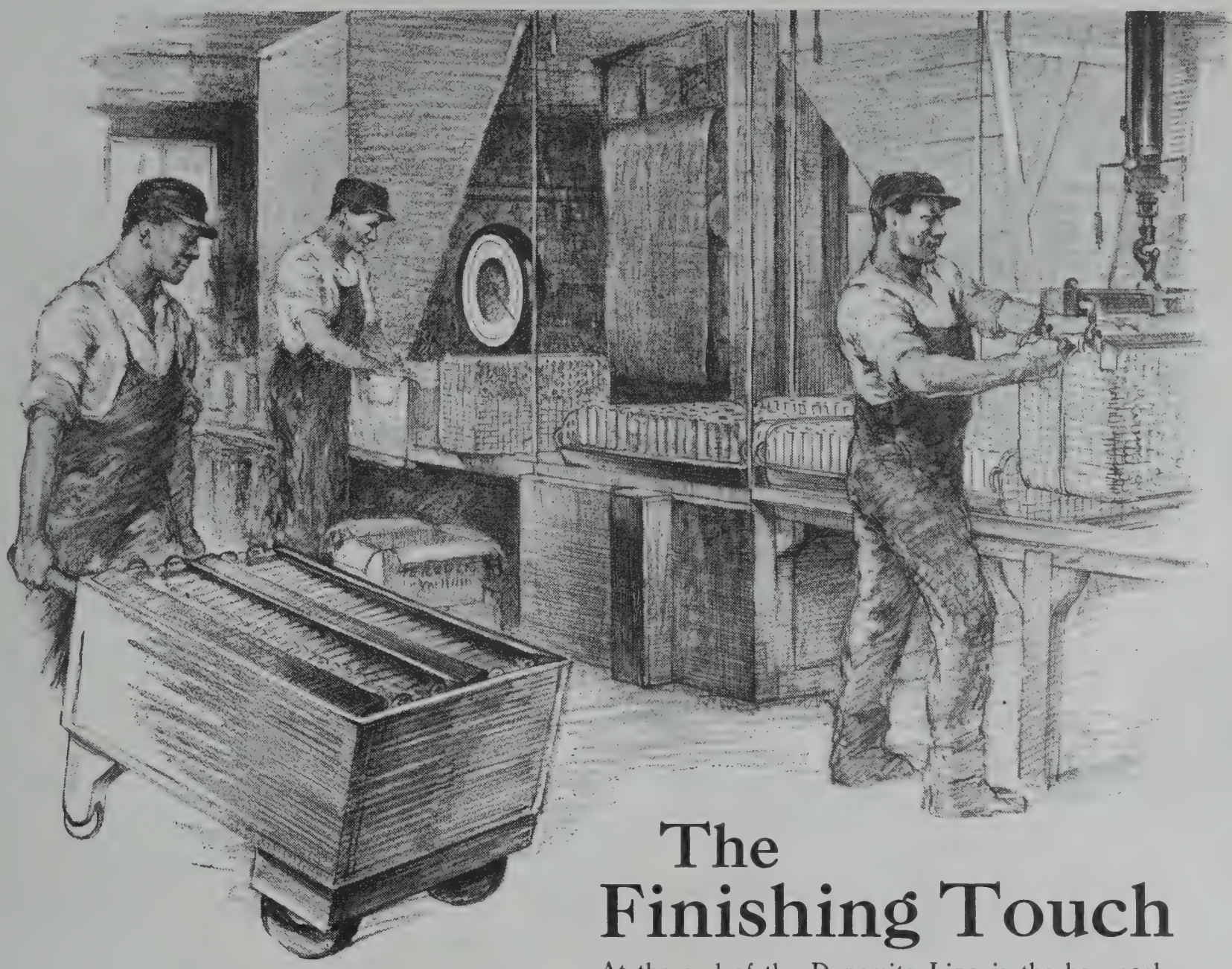

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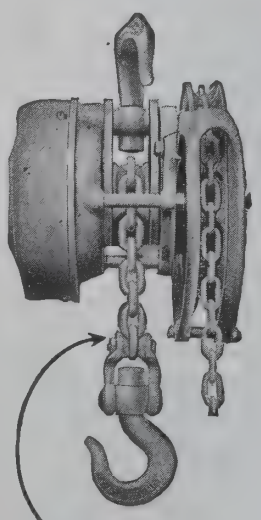


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SPUR-GEARED BLOCK

## Building Out the Bubonic Plague

(*Continued from page 466*)

an open door and had climbed five stories up an elevator rope.

As a result of the cutting off of their food supply, old, slick rats that had grown wise and cautious became daring and reckless when starved and hungry, and were then more easily trapped and poisoned.

Board sidewalks, old stable and warehouse floors were torn up and nesting and hiding places destroyed. Concrete took the place of wooden walks and floors. Some buildings were ratproofed by the use of concrete walls that extended for two feet under ground, while other buildings were ratproofed by elevation. Sides of doorways were lined with metal so that no rodent could chew its way through.

Warehouses in San Francisco have been vastly improved since the days of the epidemic. Amended building ordinances have provided for concrete floors in basements, ratproof foundation walls and rat screens on all openings in foundations. Owners have found that these improvements were paid for in a few seasons by the elimination of loss from rat depredations and the subsequent saving was clear gain.

It took the united efforts of the people of San Francisco together with the aid of the Federal Government and millions of dollars in money fighting day and night for more than a year before the epidemic was stopped and the last plague-ridden rat destroyed. At times upward of one thousand men devoted their entire time to the work. It was estimated that more than two million rats were trapped, poisoned and otherwise put to death.

Following the outbreak in San Francisco there was an epidemic of bubonic plague in New Orleans in 1914. The latter city however, had the advantage of the experience gained in San Francisco, consequently the work was carried on more intelligently from the start. Notwithstanding this it cost the city of New Orleans eight millions of dollars and fifteen months of hard work in ratproofing buildings and wharves with concrete and metal and destroying rats.

Aside from the danger of bubonic plague, the rat is responsible for an annual economic loss that is staggering, within the confines of the United States alone. The destruction occasioned by these little four-legged vandals is so immense as fairly to bewilder one who reads the figures for the first time.

Mr. David E. Lantz, assistant biologist of the Bureau of Biological Survey for the United States Government, estimated in 1917 that the total annual loss from this pest would amount to at least $200,000,000. With the present greater value of food stuffs and materials that are subject to rat damage, the loss will undoubtedly reach nearer $300,000,000 per year at this time. The yearly rat damage in various cities in 1917 was estimated by the Biological Survey, after careful investigation, for Washington as $400,000; for Baltimore, $700,000; for Pittsburgh, $1,000,000. The Woman's Municipal League of Boston announced in 1917 that the annual loss in that city from rat depredation would amount to $1,350,000.

A professional rat catcher in Los Angeles recently estimated that the number of rats in that city would at least equal the human population. As there are approximately 700,000 people in Los Angeles, one can get an idea of the rat colony in that one city alone. It was estimated by investigators in Los Angeles that the destruction of food and other property by these little marauders would average one and one-half cents per rat per day. In seaport towns where there are extensive wharves as in New York, Boston, New Orleans and San Francisco, there are probably many more rats than people.

The people who live in the country suffer a loss from this source as well as those in the city. In one field of over one hundred acres of corn raised by boy scouts, rats climbed six feet up the stalks to reach the ears and destroyed approximately ten per cent of a large crop.

The brown rat, which is the variety that predominates in this country, owing to its ferocity, strength and fecundity multiplies with alarming rapidity. The young female rat breeds when three or four months old. If food is plentiful, they will breed from six to ten times per year and produce in the middle part of the United States about ten young to the litter. The period of gestation is twenty-one days.

The economic loss caused by the rat concerns us all. It is quite natural for the merchant, the manufacturer and the farmer to include this leakage in their cost of doing business, along with interest on the investment and other overhead expense. They must have some profit in any event. The final goat—the ultimate consumer—eventually pays the bill. But the cities of San Francisco and New Orleans have demonstrated that the rat menace can be effectively checked by building it out.

## Airbrakes for the Automobile

(*Continued from page 467*)

Our first photograph shows the accumulator valve. This water-jacketed valve is usually installed in the priming-cock opening on any one cylinder of the engine and maintains automatically a constant, dependable pressure in the reservoir. A small quantity of air (or spent gas) is forced through the accumulator valve at each explosion stroke until the pressure in the reservoir balances the pressure in the cylinder. The accumulator valve then remains closed until the reservoir is reduced or excess engine pressure is generated. About twenty or thirty revolutions of the engine are required to raise the tank pressure high enough to balance the engine compression. After this pressure is reached, no loss in engine efficiency will occur, but the effect on the engine is not noticeable even when the tank is empty.

When coasting down a long hill, the engine may be shut off as usual, and the compression will generate ample pressure to control the brakes properly. If for any reason the hose should break the brake will be automatically applied.

## Automobile Signals for Danger Spots

(*Continued from page 467*)

switch out of gear before the wheels reach the main operating tread so that the motor will pass on silently in speeding away from the signal and danger.

The signal is designed so that it can be operated either by electricity or mechanical means. The average automobile wheel traveling at a speed of 20 miles an hour remains on the tread only one one-hundredth of a second. On this account it has been necessary to develop a time switch to prolong the action of the signal to from one to ten seconds. In the electrical signal efficient use has been made of a weighted fly wheel operated by a pawl from the main shaft. This four-inch fly wheel is hung on ball bearings and carries a cam for raising or lowering a brush, the arrangement being such that when the fly wheel comes to a balance, the brush is insulated or the current is broken. The ratchet which is worked by means of the pawl has only two teeth corresponding to the balance or rest of the wheel and the occasional dead center which may occur. The end of the pawl clears the fly wheel when it is rotating. Its purpose is to prevent the possibility of the signal light, bell or horn operating continuously if accidentally the tread should happen to be pinned down under a stationary car. The signal itself responds only to a heavy blow and will

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# PATENTS

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not work when only gentle pressure takes place on the tread.

It is to be hoped that this signal will not be robbed of its effectiveness in the same way that the ordinary caution signs have been spoiled, by being posted at all sorts of trivial supposed "danger spots." When one runs over a road which is posted "Danger Ahead," "Caution," "Run Slowly," etc., at the summit of every ten-yard declivity and at the neck of every slightest twist in the roadway, the best intentioned driver in the world cannot help acquiring a feeling of contempt and disregard for these superfluous warnings. They should be reserved for the places that are really dangerous and really more or less blind, so that whenever one comes upon them one may be assured that there is really something ahead, beyond what is immediately obvious. The finest warning in the world is worthless if cheapened as are the danger signs in many parts of New Jersey and Pennsylvania.

In addition to this device, Asheville, as one of our photographs shows, is in enjoyment of a procedure which might well be made universal and compulsory. When the street is wide enough to permit it, practically all municipalities require parking of cars perpendicular to the curb instead of parallel thereto, since this at the same time makes it possible for any car to get in and out without disturbing other cars, and furnishes accommodations for considerably more cars. But in most places where we have observed this convention, it is customary for the cars to back in to the curb and park front to the street. Asheville, as our picture shows, enforces the reverse procedure, which is altogether good, since it is much easier to run into the narrow passage between two cars when going forward, while the process of getting out again, once the car is in, is equally easy whether performed forward or backward. This is a convention which might well be universally copied.

## Putting the San Joaquin to Work

(*Continued from page 470*)

dation for the dam, the entire stream of the San Joaquin River was diverted by excavating a cut 30 feet wide and 250 feet long, the water being led away by a flume carrying the water to a point below the dam, after which the water again resumed its nature channel. This diversion enabled the men to work in the dry bed of the stream, and construction was pushed with great speed. The dam is built in the form of an arch, and is approximately 36 feet thick at the bottom, and has a maximum radius of 200 feet. Across the entire crest of the dam are mounted Taintor gates 20 feet in width and 14 feet in height, through which the entire flow of the San Joaquin River during flood can be handled without backing up the water to interfere with the operations of plant No. 1 of the company, approximately 2½ miles upstream. Power for the construction work was secured from this plant.

Material for the concrete work was obtained from the immediate site of the dam, as excellent supplies of rock were found there, and a crushing plant, with a capacity of 25 yards per hour, was installed. By placing this crushing plant on the side of a hill all the material handled was moved by gravity through chutes, placed at 55 degrees slope, thus avoiding the necessity for elevators.

A fleet of 14 motor trucks of from 2 to 5 ton capacity carried the freight from the nearest railroad to the incline tramway, and since it was found necessary to sprinkle the roadway on account of the dryness of the earth, a pipe line was laid along the entire distance of road built and water wagons kept the dust laid at all times.

Work on the tunnels was carried on at five different points simultaneously, and as removing the tunnel muck proved too slow by hand, steam shovels were in-

# He Tore Up the Blueprints

THE chief engineer of a $5,000,000 plant in one of St. Louis' new industrial districts prepared plans and specifications for an $800,000 generating station to supply electric current. He figured that an immense quantity of refuse which could be used as fuel in the generating station would be provided in the daily operation of the plant

Inquiry developed that St. Louis has a dual supply of cheap hydro-electric current and steam-generated energy in plentiful quantity to serve all industries that locate in St. Louis. The company found that St. Louis is girdled with an interlocking transmission system between the two sources of supply, giving interconnection through eight substations strategically placed throughout the city.

The company was convinced. The engineer tore up his blueprints. The plan to build an $800,000 generating station was abandoned. The company found that it could dispose of its fuel refuse in other ways and buy its power current in St. Louis cheaper than it could generate its own supply through the use of the refuse.

## St. Louis Has Abundant Electric Power

One of the essential factors in industrial development these days is an ample supply of reliable electric energy sold at rates which enable manufacturers to use it in large blocks economically. St. Louis is in a remarkably advantageous position in this respect. It has a large capacity of electric current from the Keokuk Dam and a local steam generating plant located directly on the Mississippi River.

Among the industries now being furnished with electric energy from St. Louis' plentiful supply are shoe, ice, automobile, drug, iron and its allied industries, drying ovens, brass and enameling ovens, electric steel and gray iron furnaces, mills and factories in almost every line of industry.

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*Screw machine products*
*Farm implements*
*Rubber products*
*Locomotive works*
*Blast furnaces*
*Cork products*
*Small hardware*
*Dye stuffs*
*Drop forge plants*

The booklet, "St. Louis as a Manufacturing Center," gives details that will interest you. A letter will bring it if addressed to

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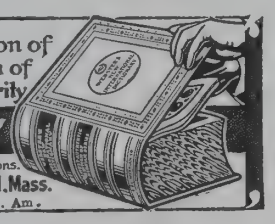



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stalled and these loaded directly upon dump cars which were hauled away by electric locomotives, trains being made up of five or six cars. Except where water was encountered in large volume, some of the tunnel crews made as high as 12 feet a day, and the work of drilling and mucking went on simultaneously. A heading, approximately 8 feet high and the full width of the tunnel, was carried approximately 7 feet ahead of the bench. As soon as the shooting from a preceding shift had been completed, the steam shovel men immediately commenced to load out the muck which had been blown back from the face. The machine men and chuck tenders at the same time start work on the top of the muck and shovel back the material which still remains on top of the bench. By carrying a short bench, it is possible to clear the same with a minimum amount of hand mucking, thus enabling the drilling in the face to proceed at the same time that the steam shovel is mucking out the heading. This makes it possible for the tunnel work to proceed through the entire 24 hours of a day.

At one of the tunnels a different method of work was adopted. Here the crews were divided into drilling and mucking gangs, and worked separately. A car was specially built upon which was mounted a column 17 feet high with a jack on each end, with 4 cross bars mounted on the same, the drills being mounted on the cross bars. By this method the entire face of the tunnel was drilled and shot before the steam shovel started to work, and each crew worked in shifts. By this method a maximum speed of 90 feet in one week was obtained. Considerable rivalry existed between the various crews, and as the progress made by each crew was posted, the men working in the different tunnels endeavored to outdo each other with the result that excellent progress was made in all departments.

The three penstock lines are of riveted steel pipe, 7 feet in diameter at the lower end and 8 feet in diameter at the upper end, at which point they are concreted into the mouth of the tunnel. A forebay 17 feet in diameter at the top, 80 feet in height and 40 feet in diameter at the top of the tunnel, has been excavated in solid rock a short distance from the outlet of the tunnel, where the penstock joins the same. The purpose of the forebay, from which a spillway leads to the river, is to take care of surges due to sudden increases and decreases in load at the plant.

From the power house a 110,000-volt transmission line about 75 miles in length carries the current to a point near Tulare Lake, where it is delivered to the distributing system for use where needed. Since the hydroelectric lines of all California companies have been connected up for emergency use, it is possible to send power generated at one point to any part of the State for use.

### The "Super-Destroyer"

(*Continued from page 472*)

the guns, including director aiming and firing mechanism. It is, however, doubtful whether all this cumbersome and intricate gear was suitable for vessels which were simply enlarged destroyers, and therefore exposed to the sort of rough and tumble fighting in which headlong dash counts for more than science. Moreover, experience in other navies shows that the 5.9-inch gun, with its 101-pound projectile, is much too heavy to be conveniently manhandled on the slippery decks of a boat which is moving all ways at once. In theory, the German "V-116" leaders ought to have made short work of any destroyers they were likely to meet in the North Sea; in practice they would probably have been beaten by the smaller British boats armed with the handy 4-inch and 4.7-inch gun.

A particularly formidable type of flotilla leader is represented by the five new Japanese boats of the Akikaze class, building under the estimates for the current year. They will displace 1,900 tons and have a speed of 38 knots. Four, or possibly five, 5.5-inch 82-pounder rapid-fire guns will be mounted on the centerline, and all six torpedo tubes can be trained on either beam. A feature of these boats is their large fuel capacity, which is expected to give them a cruising radius of 3,500 sea miles at economical speed.

It will be seen that the modern flotilla leader approximates to the light cruiser in dimensions and armament. If the recent rate of progress is to be maintained, "boat" will soon become a misnomer, and we shall revert to the "torpedo cruiser" of thirty years ago, though on a much larger scale. In the destroyer and flotilla leader, as in every other type of fighting craft, each new demand for increased armament, speed and sea endurance involves a corresponding increase in size, and there is practically no limit except in the paying power of the nations concerned. But in every class of fighting ship there comes a stage of development which fulfils all reasonable requirements, and beyond which it is unnecessary to go. In the case of the flotilla leader this stage appears to have been reached in the smaller designs set forth in the table shown. War experience has demonstrated the all-round tactical efficiency of such vessels as the British Scott class, which, on the relatively modest displacement of 1,740 tons, combine in a high degree the essential qualities of a destroyer flagship. It is of interest to learn that a tentative design prepared at Washington last year provided for a vessel of 1,800 to 1,900 tons, of 37 knots speed, armed with four 5-inch rapid-fire guns and eight torpedo tubes.

### Golf Without a Caddy

(*Continued from page 473*)

in fact works out much more wisely than anticipated; when a few ounces can save upward of 25 tons as above, the ounces are certainly working at some high efficiency Think of the perspiration and utter exhaustion that would overtake one were he compelled to go out and raise 25 tons to the height of 1 foot by hand twice a day. How much of either energy or inclination for golf would a man have after such an exertion, or by taking the stairs climb about 30 stories in one of our tall buildings twice a day? And this is exactly what caddiless golf has been doing to us without our ever suspecting it.

With the little device I have referred to, the simple act of resting the bag down on the ground causes it to develop legs which keep it upright and very stable, and with my eye on the ball and without looking around, I am able simply to reach back, grasping the bag, and the act of lifting it from the ground causes the legs to disappear and the bag looks like any ordinary "Sunday" bag and is little or no heavier.

Another point that I have found important is the following: We all know that "keep your eye on the ball" is even more necessary after the shot is made than while making it, *if you have no caddie.* It is then the player's job to watch the ball—certainly no caddie is watching it for him. Again, one often loses the lie of the ball in the rough while stooping down to get his sticks, thus causing exasperating delays. I have found that it is certainly of surprising convenience to have the sticks right at hand, standing upright "on their toes," so to speak; and to simply reach back, grasping the bag while watching your ball, and be off on the next stroke toward the drop long before the ball lights. This is of great aid in holding your position on the course and I find often aids a whole foursome to hold its position in play. The unerring location of, and getting right off on the ball is certainly an aid, both directly and indirectly, that can hardly be overestimated.

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## Sending Photographs Over Wires

(*Continued from page 474*)

say, at one end it is absolutely opaque, but going toward the other end it becomes steadily more transparent until it reaches practical transparency. Thus the stylus attached to the microphone at the transmitting end is at a given moment on a black or high spot of the cylinder, and transmits a heavy current over the line; and this heavy current at the receiving end causes the mirror to be so pointed that the beam of reflected light strikes the opaque end of the finely graduated screen and thus fails to make an impression on the sensitized receiving cylinder. In this case the receiving cylinder will receive an impression, and using it as a photographic negative any number of positive prints can be made. It also follows that if the graduated screen is reversed, or if the polarity of the Blondel oscillograph is reversed, the receiving cylinder can be made a photographic positive.

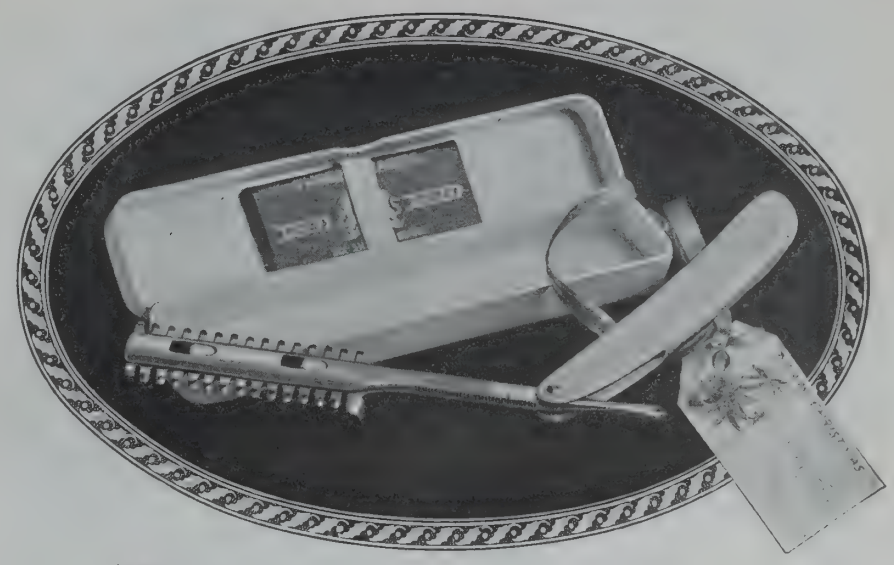
So much for the general details, but there are numerous refinements, as might well be imagined, in an apparatus capable of accomplishing such delicate work. The aperture through which the beam of light passes on to the receiving cylinder is of microscopic proportions and is made in a silver disk which presses against the recording surface. This hole is of a size corresponding to the pitch of the feed mechanism, so that the light record, made in the form of a continuous spiral, has its threads so close together that it forms to all intents and purposes a solid photographic exposure. Otherwise the spiral would have marked spaces between the turns, which would destroy the usefulness of the received photograph.

Obviously, the transmitter and receiver must operate in step or in perfect synchronism, otherwise serious distortion results. To this end a special device is used at the transmitting end, for the purpose of starting the cylinders at both ends at the same time. When one cylinder gets a little ahead of the other, a special arrangement causes its retardation until the other cylinder has caught up so to speak. This feature of the system comprises special contact members and solenoids.

The cylinder of the receiving apparatus can take a piece of film or a strip of sensitized paper, and the emulsion of either can be of such speed as to take care of the rate of operation. The cylinder is contained in a metallic case of octagonal shape, the loading of same being accomplished in a dark room. By means of a number of cylinders and containers, the receiver is operated in a manner quite suggestive of the conventional camera and plate-holders.

Regarding the rate of transmission, which is obviously an all-important factor when the main arteries of the world's communication system are to be leased for the purpose of transmitting photographs, M. Belin tells us that this is a question of quality and fineness of detail. Some photographs are not so detailed as others, hence the transmission can be done on a somewhat coarser scale. And even the finely detailed photograph can be transmitted at a faster rate if it is permissible that the copy at the receiving end be of coarser quality. Detailed photographs can be faithfully transmitted in from four to eight minutes each, while coarser photographs or those which require rapid transmission can be handled in three to six minutes. M. Belin hopes for even more rapid transmission in the near fuure.

Something has been said about another contact-making device, indicated by *C* in one of our photographs. This device is intended for the transmission of matter in straight black-and-white, as distinguished from the half-tone graduation of photographs. In this case a given piece of writing, type matter or drawing is transferred on to the copper cylinder with the aid of a special ink, thus leaving a raised impression after drying. The contact-making member *C* is simply a make-and-

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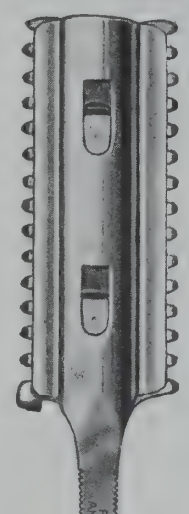

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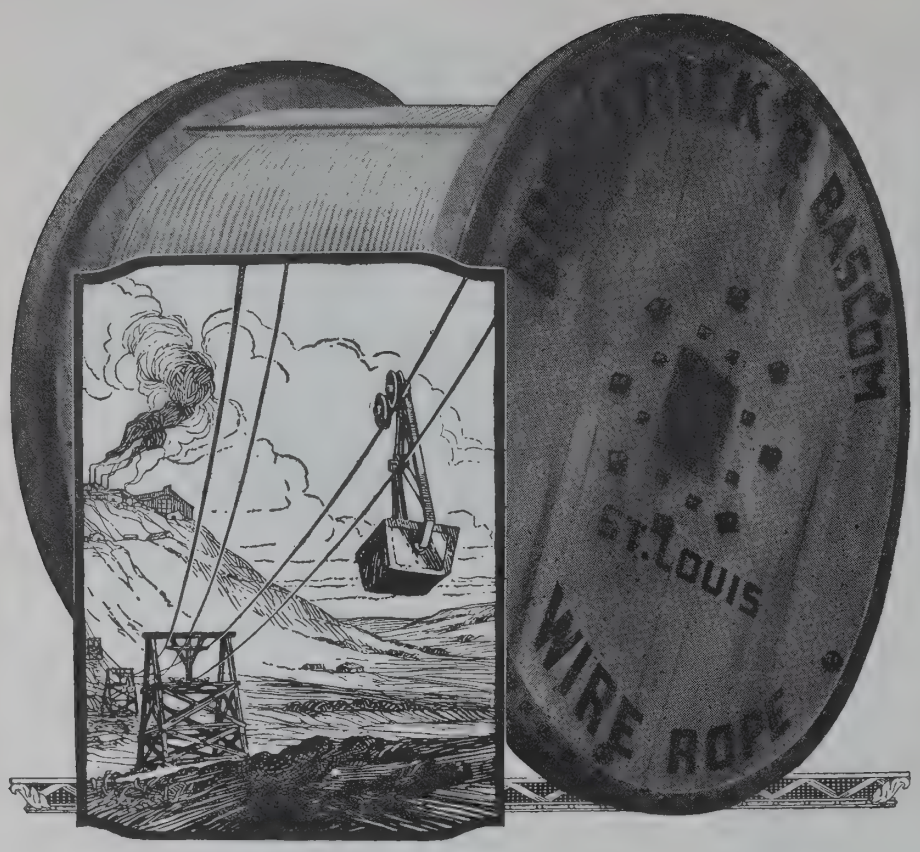


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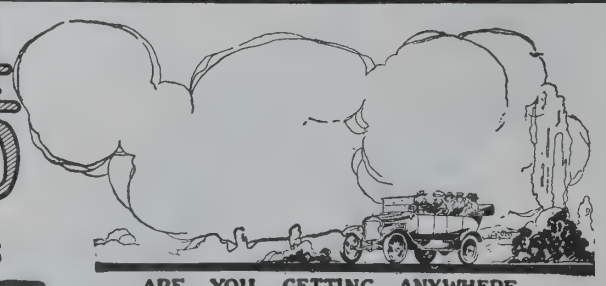

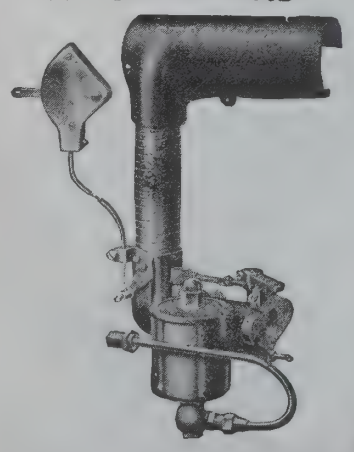

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break device actuated by its stylus pressing against and in constant contact with the copper cylinder.

At the receiving end the graduated screen is replaced by an opaque screen which has a single vertical slit. This arrangement means that the mirror has only two positions so far as the sensitized receiving drum is concerned, namely, shining through the slip and on to the sensitized surface, or striking the opaque plate and thus making no impression on the sensitized surface. In this manner straight black-and-white matter can be transmitted at a high rate of speed and the reproduction must necessarily be quite faithful. M. Belin told the writer that he had transmitted cartoons, manuscript and type matter with excellent results. Photographic proofs of printed or other matter measuring four by six inches can be transmitted in four to eight minutes, and M. Belin has under construction machines which will assure the transmission of 10,000 words of text in printed form per hour.

Aside from its application to modern journalism, which is obviously the main purpose to which all electro-photographic transmission systems can be put, there are other uses. One which suggests itself to us is in the transmission of police photographs for the identification of criminals. Such a use would prove invaluable in the running down of criminals. Then there is a distinct legal use for such a system, in the transmission of facsimile evidence, signatures, and so on. There is also a military use. Perhaps, too, the system might be put to public use, permitting anyone to transmit photographs over telegraph and telephone wires to distant friends, although it would seem that the cost of such messages must remain quite high for a long time to come.

The same system can be applied to radio, by coupling the Belin apparatus with the usual arc, high-frequency alternator, vacuum tube or other type of continuous-wave transmitter. All in all, this system is applicable wherever wires or wireless or even cable is now employed in the transmission of human thoughts.

## Recent Patent Decisions

(*Continued from page 476*)

away with the annoying tintinnabulations, is entitled to protection, where the specifications disclose the method, even though the inventor is ignorant of the scientific principles involved.

Where a person, by anything which he does or says, or abstains from doing or saying, when it is his duty to act or speak in respect of a subject matter, intentionally causes or permits another person to believe a thing to be true, and to act upon such belief otherwise than he would have acted but for that belief and he so acts, and materially changes his position in respect of the matter to his detriment, then the first person is not allowed, in a suit between himself and such other person, to deny the truth of the thing done or stated. Also, delay in prosecuting other infringers while the validity of a patent is in active litigation does not constitute laches or negligence. —*Searchlight Horn Co. v. Victor Talking Mch. Co. U. S. D. C. of N. J.*

**Patents Used by Contractor.**—This is an appeal to the Court of Last Resort of Arizona, and the decision and opinion of the Supreme Court of Arizona touches upon a matter involving patent law. The case was one brought by sureties on bonds against a street cleaning contractor concerning a series of controversies involving many issues.

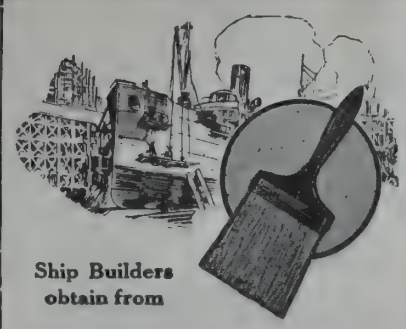
It is held that a patentee or owner of a patent has the right to charge a reasonable royalty or license fee for the use of a patented material or process, and that without procuring from the patentee or owner of a patent the right to use the patented material or process there can be no lawful use thereof. Royalties due from a contractor for the privilege of using a patented process for combining materials used in bitulithic paving, and machinery used in connection with laying such material, held covered by the contractor's bond conditioned on contractor's payment for materials furnished for the improvement. That the owner of a patent process did not file agreement to furnish all the material and give license to use of patents at definite price as required by specifications did not preclude the owner from recovering from contractor's surety for royalties due where the price was reasonable and neither the city nor property owners objected.—*U. S. Fidelity & Guar. Co. v. Calif.-Ariz. Const. Co. et al. Supreme Court of Ariz.*

## Eliminating the Flash From Rifles and Big Guns

THE production of smokeless powder at once rendered the art of locating the enemy's batteries comparatively difficult. However, such location often remained possible at night because of the flash observed upon the firing of the gun. A French scientist, M. Delpech, now proposes to suppress these telltale flashes, and his report upon the matter was not long ago laid before the French Academy of Sciences.

The ball of flame which is formed at the mouth of the gun is a result of the violent and instantaneous combustion of masses of carbon monoxide and of methane, which take fire upon coming into contact with the air, where they form a detonating mixture with the oxygen of the latter, whereupon a second explosion produces the luminous flash. If experiments be made with a "75" gun for example, with different powders, it will be seen that the flash of light is always produced with powders that employ at a high temperature of combustion, while with powder employing a lower temperature of combustion the flash is diminished in intensity. When a naval "75" which is longer, is desired, the gases are not ignited, since they are too much cooled by their passage through the longer barrel. In the same manner it is found that the same gun cartridge will produce a flash or not produce it according to whether the barrel of the rifle is short or long. These observations at once suggest the method by which the flash may be suppressed—in one way or another the gases must be cooled. One way of doing this is by adding, to the charge of powder, salts which contain water of crystallization and therefore exert an anti-thermic effect. Or the cooling may be accomplished, on the other hand, by physical instead of chemical means; and M. Delpech has demonstrated that the flash can be extinguished by the addition of 20 grams of vaseline to the charge of powder. In certain kinds of guns it is sufficient, indeed, merely to apply a plentiful coating of grease to the projectile. No change either in the pressures or in the speed of projection takes place but the flash is extinguished.

The suppression of the flash is more difficult in the case of big guns, because the mass of gas formed is so enormous. But it can be successfully accomplished, according to this investigator, by greasing the entire surface of the cartridges with grease or vaseline (20 per cent of the weight of the powder). These flameless powders were first obtained in 1917, and have given entire satisfaction ever since the time when at M. Delpech's suggestion the diminution in the liberation of heat was compensated by a corresponding increase in the weight of the powder (4 per cent). The anti-flash effect is obtained by introducing 2 per cent of vaseline into the powder. The suppression of the flame is complete with the guns experimented upon. The vaseline in no way modifies the firing action, the pressure and the rate of speed remaining unaltered; furthermore, the vaseline is found to exert a powerful stabilizing action upon B powder.—By *M. Tevis.*



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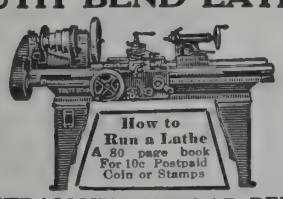


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(14345) W. S. A. writes: I was interested in Lieut. C. C. Harshman's account of "A Moonlight Rainbow" in your issue of July 3rd. This phenomenon is considered to be rather rare, but I saw one in England many years ago. This was a perfect bow, but lacked the coloring seen in the solar rainbow. I have always understood that lunar rainbows are colorless, but Lieut. Harshman does not refer to this feature in his account. A. Lunar rainbows are rare occurrences. The moon must be near its full and not far above the horizon for one to be seen. The bow will be on the opposite side of the horizon from the moon. Lunar halos are frequent on the same side as the moon. If early in the evening the bow will be in the west and the moon in the east. The writer has seen two lunar bows, both in the same evening, and about a half hour apart; faint colors could be seen red and yellow as he recollects. Never more than three are recorded, red, yellow and green, and it may be that some of these are to be ascribed to the imagination. As the writer recalls it, the lunar bow is spoken of in a very old book, "The Phenomena of the Four Seasons," by President Hopkins of Amherst College. He says in substance that a person may not expect to see more than one in a lifetime, ranking it with the wonderful coloring of autumn leaves, and a grand ice storm of winter with all the colors of the spectrum brought out in the ice crystals by the sun shining upon an earth covered with wonderful crystals.

(14346) J. C. asks: Could you please tell me the critical temperature of hydrogen, carbon, boron, aluminum, or any element? Understand I mean the *critical temperature.* 2. Could you state the thermal energy of the sun per square yard at our earth's equator? 3. Could you give me any information on the way the American Telephone Company has so increased the voice amplitude in apparatus? Is it by means of a new coil in wiring—as there are only two coils in wiring, to wit: Henry's coil and Pupin's coil—do you know if there's a new coil brought out by the aforementioned company's engineering staff? A. 1. The critical temperature of hydrogen is given in the Smithsonian Physical Tables as —240°.8°C. and the critical pressure is 14 atmospheres. There are no critical temperatures given for the other elements which you name: carbon, boron and aluminum, in the tables quoted above. Critical temperatures belong only to gases and these elements vaporize only at very high temperatures. Aluminum boils at 1,800°C., carbon is computed to boil at 3,600°C. and is known to volatilize without melting in the electric oven, while boron volatilizes without melting in the electric arc, the temperature of which is that of the carbon vapor which conducts the current across the space between the electrodes by its ionization at not less than 3,500°C. The figures given are from the tables quoted above, excepting the last for the temperature of the electric arc. 2. The Solar Constant of Radiation, as it is termed, is about 1.95 calories per square centimeter per minute, as given in the latest book upon the subject, "Abbott's Sun." Dr. Abbott is director of the Smithsonian Astrophysical Observatory and our highest authority on the subject. This number is the same for any place on the earth since it is the heat energy outside of the atmosphere received by a surface at right angles to the rays of the sun. Of this quantity perhaps 5/8 reaches the earth's surface, the rest being absorbed by the atmosphere. Of course the amount of absorption varies with the dust in the air and the angle of incidence upon the surface of the earth. 3. The amplification of the telephonic current is not produced by coils principally, although transmission to a distance was brought about by Pupin by securing resonance of the telephonic circuit by the addition of coils to the circuit. Amplification is


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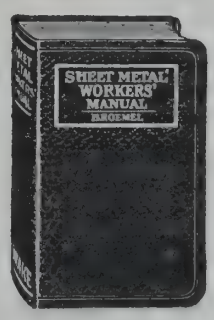


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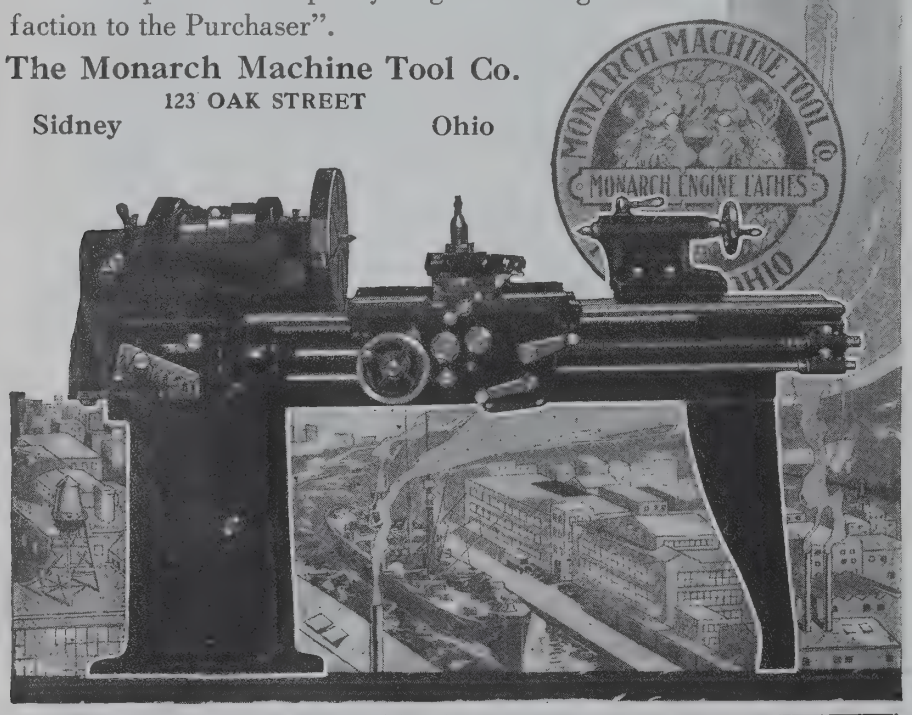


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The *National Guard,* which is rapidly increasing in strength was to September 30, 1920: Officers, 2,642: men, 62,903; total, 65,545.

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due to the vacuum bulb or audion, which is the invention of Dr. Lee DeForest. The radio engineers of the Western Electric Co., the U. S. Bureau of Standards and others worked out the system during the war by which wonderful amplification of the voice in the telephone and the wireless telephone became possible.

(14347) H. J. S. asks: Will you be kind enough to send me information on the following? From time to time there have been articles published in newspapers and magazines concerning the so-called "Edison Star." This star was supposed to be sent up from the Edison laboratory. The fact has started quite a discussion and while I read several articles including one of recent date by Garrett P. Serviss in the N. Y. American stating no such thing ever existed, the question remains unsettled. Will you be kind enough therefore to advise me whether or not such a star exists or ever existed? A. While Mr. Edison was working out his system of electric lighting at Menlo Park, New Jersey, some bright intellect started the story that he was in the habit of hoisting a light at early candle light and lowering slowly a little later in the evening. This light was actually seen from New York, it was said in the west. This was Mr. Edison's star. The light was seen in the west all right, but it was not an electric light over Mr. Edison's laboratory. It happened that at that time the planet Venus was bright in the western sky a little after sunset, and slowly sloped to the west setting in late twilight. It was the evening star which gave currency to the tale of the brilliant inventor of the story. This was in 1873-1876, and it seems the story is not dead yet. Nor is it likely that the truth will now overtake the lie. Professor Serviss is quite right, although he makes no explanation.

(14348) W. G. C. asks: I have read many times the theory given for hail storms, the idea being that the wind blowing in a rotary motion carries the rain drops high up in the cold air and back again into the rain cloud and so on but I have never seen any reason why we should get our hail storms after very warm weather for several days. The idea occurred to me that during very warm weather a large amount of very dry air might rise and gather high above the earth. When a shower comes up and rain falls through the very dry air this air absorbs a large amount of moisture or really produces rapid evaporation and intense cold on the same principles as the evaporation of gasoline in the auto carburetor produces cold. My idea was that rain passing through this layer of air after it had been chilled and absorbed all the moisture it could would be frozen and fall as hail. Could this be possible? A. The theory that hail stones are carried up and down several times before fallin from the cloud is based upon the fact that there are usually in them several layers of ice separated by softer material, more like snow. It seems necessary to suppose that the mass has passed from a colder to a warmer region several times before it bcame heavy enough to fall out of the whirling air. It is not thought that fhe ball passes from one whirling mass of air up into another but that it is whirled up and down in the hail cloud itself. It would be difficult to see how the stone could pass out of the whirl in which it was borne into dry air and back again to be carried up and down in this way several times. That it takes on material which is frozen hard after it is received can hardly be doubted. It may be that your conception of a mass of hot and dry air below the cloud is correct. It can easily be worked into the ordinary theory of the formation of hail stones. Any theory must account for the several layers of harder ice which are found in the large stones by cutting them open.

(14349) T. D. asks: Can a sail boat be sailed so that it will travel faster than the wind, if so, how will it be headed? Will a sail boat travel faster directly with the wind than in any other position? A. A sail boat cannot move through the water as fast as the wind which drives it, since it must move its own weight of water out of its path every time it moves its length. A sail boat makes its best speed with the wind abaft the beam, or on the quarter as it is called. This subject is fully discussed and figures given for different sizes of boats in the leading editorial of the SCIENTIFIC AMERICAN of July 31, 1920.

(14350) H. J. P. asks how to refine platinum filings. A. Spread out filings on a large piece of paper and go through carefully with a pair of tweezers to get any solid pieces of gold and platinum, then sift well through a strong steel magnet. Speaking of magnets, see that there is plenty of strength; do not


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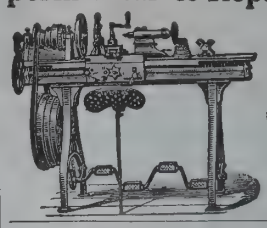

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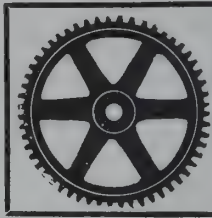

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use an old one that may have been in a factory a number of years and be played out. Having gotten a good one, always keep a piece of steel on the two ends to keep the magnetinsm from running out. In passing the magnet through small atoms of gold and platinum will adhere to the iron or steel filings. These may be put into an old pickle crock (sulphuric acid and water), which will eat the iron or steel and precipitate the precious metals. When a sufficient quantity is recovered these filings are placed with the others for separaitng. If a lot of oily waste, buffs, etc., are in the stuff to be refined, the same should be put into an iron pot or large iron frying pan and burned out over a gas plate before putting the magnet through. After separating, place in a large evaporating, porcelain dish and to every ounce of filings add three ounces of chemically pure muriatic acid and one ounce of nitric acid. While any quantity of filings may be treated yet it hardly pays to put less than 20 ounces through at a time. If filings are largely gold, the acids, which are previously mixed in the proper proportions, should be added slowly and a little at a time for a rapid action would result in the mixture rising and spilling over the edge, thereby losing some of the metals. The dish should be placed on a sand bath over a gas plate burner and should be kept hot. A glass funnel may be placed over the dish to prevent loss. When all is dissolved, which may be ascertained by stirring with a glass rod, turn off the gas and let cool. Then pour into large crock in which are ten or fifteen quarts of rain or distilled water or water which has been boiled and cooled. Let stand a few hours, or until next day, and a precipitate will be found on bottom of crock. This is chloride of silver. Carefully siphon liquid into another crock, or pass through a funnel with filtering paper to recover any articles or silver which may be still in the liquid; mix up about 20 ounces (for 20 ounces of refinings) of fresh powdered sal ammoniac in a little water, pour in liquid and stir well. In a few hours the platinum will be found on the bottom of the crock. The liquid is siphoned off into a fresh, clean crock, filtered to recover any further traces of platinum and with the precipitate well dried and subsequently melted in the regular furnace. The gold is recovered from the liquid by adding about an equal bulk of water and dissolving about 20 ounces of sulphate of iron (green copperas) in a little water, add and stir thoroughly. Let stand for a few hours, pour or siphon off liquid and the gold will be deposited in bottom of crock in the form of a muddy brown sediment. This is collected, dried and melted in regular crucible. The liquid will contain traces of all the metals, also the copper used in alloying, so should be poured into sink for further recovery by the refiner. The metals recovered this way are not chemically pure, only commercially so, and are used in the general run of jewelry manufacturing. It is safe to assume that in the melting of platinum all traces of silver, copper, etc., are destroyed as the high temperature would cause these metals to volatilize so that only probably metal remaining would be iridium. Sometimes this metal is not dissolved and it is thrown down with the silver. To separate, dissolve the silver in nitric acid only, dilute well with water and hang in a few pieces of copper, old boiling out pans will do, and in a day or two the silver will be thrown down when it may be dried and melted with a little borax. The iridium, trace of platinum, etc., not being attacked and dissolved by the nitric acid are recovered from the bottom of crock and melted. If all details are carefully carried out, the average shop can get out its own filings. In mixing and adding filings to acids in the first operation, the acids must be well heated before action, especially on platinum, takes place. The acids must be well put in dish first, well heated and the filings sifted, in a little at a time, stirring well with a glass rod, so that metals are constantly exposed to the acid. The amounts of sal ammoniac and copperas (20 ounces each) are for about a like weight of the metals and should be, of course, reduced or increased in proportion. All work with acids should be done in a separate room or where there is a large chimney to carry off fumes. Some refiners use oxalic acid in place of the sal ammoniac; results are the same. To be sure of getting strength it is best to buy sal ammoniac in lump form and pulverize it as mortar is required.

(14351) A. D. McN. asks: Will you please tell me whether creosoted wood is an electrical conductor or an insulator. A. Creosote is an insulator, and wood treated with creosote would have higher insulating value than when untreated.


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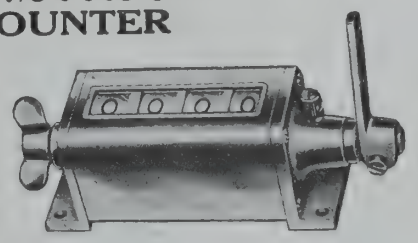

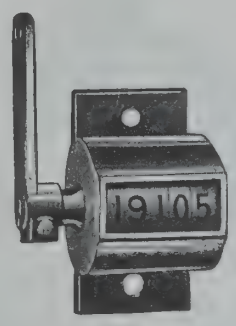


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## NEW BOOKS, ETC.

"Practical Engineer" Electrical Pocket Book and Diary for 1920. London: The Technical Publishing Co., Ltd. 18mo.; 755 pp.; illustrated.

This familiar British annual comes of age with this issue, which maintains the usual practical balance between the comprehensive and the compact. Great Britain has recently sought to relieve inventors by a new Patent Act; its main provisions will be found here, with many other up-to-date additions and revisions. The buyers' guide in French, Spanish and Russian is a markworthy and helpful section of the little book.

Motionism. By E. J. McCarthy Morris, F.R.C.S. London: The Caxton Press, Ltd. 12mo.; 130 pp.

"Motionism" is an attempt to explain the visible world, and to furnish an acceptable foundation for a universal religion or ethical philosophy, by taking as starting-point a simple experiment from which the author arrives at a "trinity" of matter, mind and motion.

Silver. Its Intimate Association with the Daily Life of Man. By Benjamin White. New York: Isaac Pitman and Sons.

The author, a British economist and statistician, sets before us the story of silver, from mining, extraction and marketing to its consumption by the arts and industries and its use as currency. He pays a compliment to the annual report of the Director of the United States Mint as "the principal, one might almost say the only, authority upon world statistics." The interesting little work quotes freely from this source.

Acids, Alkalis and Salts. By G. H. J. Adlam, M.A., B.Sc. New York: Isaac Pitman and Sons. 8vo.; 112 pp.; illustrated.

While this handy little book devotes some space to theoretical considerations that initiate the student into the study of chemistry, its aim and end is rather instruction in the commercial and domestic importance and uses of these wonder-working substances. Its facts are simply and interestingly put before the reader, and form a very good introduction to further study.

Employment Psychology. The Application of Scientific Methods to the Selection, Training and Grading of Employees. By Henry C. Link, Ph.D. New York: The Macmillan Company, 1919. 8vo.; 440 pp.; forms.

Psychology as applied to industry has now reached a point where methods and results may be beneficially compared and judged. The employer wants to select the fittest applicant, and to bring him to maximum efficiency by the quickest and soundest methods. The author of this work avails himself of the experience of both psychologists and industrial experts. He takes a representative industry and gives an impartial account of tests under working conditions; guides the reader to a practical investigation of such tests; and enables him to put the right tests into operation. Anyone considering the abolition of old, happy-go-lucky methods will appreciate the concrete help the volume extends.

Silvanus Phillips Thompson, D.Sc., LL.D., F.R.S. By Jane Smeal Thompson and Helen G. Thompson, B.Sc. New York: E. P. Dutton and Company, 1920. 8vo.; 372 pp.; illustrated.

This biography portrays the scientist through his work; it is a charmingly written and inspiring record of a busy and useful life. As lecturer, writer, discoverer and inventor, Thompson contributed largely to electrical science, wrote biographies of Faraday and Kelvin, delved into light and radiation, and optics and illumination, and received, if somewhat tardily, recognition in a long list of honors and degrees. Thompson had also a delightfully human side; he wrote poetry, painted pictures, and took a huge enjoyment in family life. His many-sidedness is faithfully reflected in the biography, and makes it absorbing reading for all, whether scientists or not.

British Airships. Past, Present and Future. By George Whale (Late Major, R.A.F.). New York: John Lane Company, 1919. 12mo.; 244 pp.; illustrated.

In 1914 the British airship was rather a joke. The war period saw the British airship fleet the largest in the world; it cruised 89,000 hours and covered two and a quarter million miles. Major Whale follows this remarkable development step by step, using 24 plates to illustrate army and navy types. The airship's sterling work in the war is crisply reviewed, and the reader is enabled to talk intelligently of rigids and non-rigids, gross and net lift, and the operation of ballonets. Some of the prophecies of the final chapter, notably the crossing of the Atlantic, have already become historical facts.

The Roman Civilization. By A. F. Giles, M.A. London: T. C. and E. C. Jack, Ltd. 8vo.; 160 pp.; illustrated.

This is the fourth volume of a series called "Through the Eye," in which the text, though fairly copious, is subordinate to the pictures, and omits sujects that do not lend themselves to pictorial treatment. This method holds the attention, and gives a fresh impression of social, economic and political conditions in old Rome. Religion, militarism, art and industry are all reflected in the beautiful plates. The text is for the most part taken from another volume by the same authority, but has been rearranged and thoroughly revised.

The English of Commerce. By John B. Opdycke. New York: Charles Scribner's Sons, 1920. 8vo.; 435 pp.; illustrated.

Business English is an art in itself; like literary English, it must be correct and attractive, but in addition it must possess a dynamic force that persuades to action. Many of its terms, too, are peculiarly its own; these are ignored in the schools. Mr. Opdycke's work applies words and sentences to definite ends, teaches how to write convincing human letters in place of the atrocities of the past, is particularly helpful in advertising and face-to-face salesmanship, and will make itself invaluable to all who would energize their business language. Every page abounds in sound principles and the best practise.

Business Law. By Thomas Conyngton. New York: The Ronald Press Company, 1920. 2 vol.; 8vo.; 870 pp.

With laws pouring in a steady stream from our federal, state and municipal law manufactories, it becomes increasingly difficult for the business man to avoid the *verboten*, however honest his intentions. Still, there are guiding principles and general rules a knowledge of which will help the man of affairs immensely. These principles a lawyer who is himself schooled in practical business sets forth in this well-ordered working manual. It covers in the form of an edifying reading course all the main divisions of business—contracts, sales, insurance, employment, patents and trademarks, taxation, and many other points, providing the business man with an authoritative basis upon which to make all decisions involving business and property.

Paints and Varnishes. By Arthur Seymour Jennings, F.I.B.D. New York: Isaac Pitman and Sons. 12mo.; 108 pp.; illustrated.

This helpful manual of condensed information treats of paints and varnishes with particular reference to their properties and uses. Property owners and architects, as well as painters, will find here the characteristics that determine quality, the quantity necessary to cover a given surface, and the probable durability of the coating, with descriptions of paint-making machinery and the latest spraying apparatus. Whitewashes, distempers and enamels are included in the discussion.

Agricultural Prices. By Henry A. Wallace. Des Moines, Iowa: Wallace Publishing Company, 1920. 8vo.; 224 pp.; illustrated.

Innumerable persons are directly concerned with farm product prices. This work will be useful to all such, and more particularly to agricultural students, corn-belt farmers, and farm organizations. The reader will gain from it a precise knowledge of price-making factors and forces; to understand a force is to be in a position to cope with it intelligently; and in the case in point there is hope that a wider understanding may result in the avoidance of costly mistakes, fair compensation, and less violent fluctuations. The work is adaptable to college courses, and stresses the application of statistical laws.

New York Charities Directory, 1920. By Lina D. Miller. New York: Charity Organization Society. 8vo.; 417 pp.

Social service is carried on in so many different ways, by so many different organizations, that this Directory of Greater New York's activities is absolutely necessary to those who need to trace its ramifications. The 1920 edition provides easy approach, not only to the institutions whose names are known, but to all organizations of any desired class, of any required borough, and also to the individuals prominent in the administration of the various efforts toward health and rehabilitation. Its scope is broad, and includes religious, educational, medical, industrial and civic work.

IN THIS ISSUE:

THE STATE AND THE FARMER
SOLVING THE LABOR PROBLEM

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

A CHAIN BUCKET MACHINE THAT DIGS, SHREDS AND SCATTERS PEAT.—[See page 498]

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November 13, 1920

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| Akers & Harpham Co. | 2 | John D. Coneau | 1 | Louis Hartman & Sons | 1 | McMahon Transportation Co. | 6 |
| R. T. Allen & Bros. | 1 | Conrad-Baisch-Kroehle Co. | 2 | Haverty Furniture Co. | 3 | R. A. McWhirr Co. | 1 |
| American Stores Co. | 1 | Criss Bros. | 1 | J. Clark Helms | 1 | Madary's Planing Mill, Inc. | 1 |
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| Andre & Andre | 1 | Culmerville Auto Transit Co. | 1 | Hession, Florist | 1 | Marathon Auto Drayage Co. | 1 |
| Andrews & Horigan | 1 | W. J. Daly Co. | 2 | Higbee Co. | 1 | Marsh-Murdoch Coal Co. | 1 |
| Anthony Bros. | 3 | Davis Furniture Co. | 1 | Highland Motor Transfer Co. | 1 | The May Co. | 1 |
| John Arata & Son | 1 | Denver & Pueblo Construction Co. | 1 | Highway Transit Co. | 1 | May & Co. | 1 |
| Joseph R. Arbiter Co. | 1 | Frank J. Derry | 1 | R. A. Hilborn | 1 | Henry P. Mayer Music House | 1 |
| Atlantic Ice & Coal Corp. | 15 | Diamond Spring Brewery | 1 | Holder Coal Co. | 1 | John Meckes Sons Co. | 2 |
| Atlantic Refining Co. | 5 | August Doemling | 1 | Holm & Olson | 1 | Merchants Biscuit Co. | 1 |
| Christian Atz | 1 | Dorchester & Rose | 1 | Horstmeyer's Grocery | 1 | Mesaba Transportation Co. | 6 |
| Bakersfield Truck Co. | 1 | Downes Lumber Co. | 1 | M. L. Hullett | 1 | Michaud Bros., Inc. | 3 |
| A. L. Bartlett Co. | 1 | Duncan & Goodell | 1 | Hursen Undertaker, Inc. | 1 | Michigan Seating Co. | 1 |
| F. X. Baumert | 1 | F. B. DuPree | 1 | Independent School District No. 51 | 1 | Julius Miske | 1 |
| Bekins Van & Storage Co. | 1 | Duquesne Transfer Co. | 2 | Interstate Auto & Supply Co. | 1 | J. E. Monahan | 1 |
| Benicia & Vallejo Stage Line | 2 | East Ohio Gas Co. | 1 | Interurban Auto Car Co. | 1 | Moore Transfer Co. | 1 |
| Bellevue & Allied Hospitals | 1 | T. Eaton Co., Ltd. | 3 | I. M. Iralson & Son | 1 | Moore-Handley Hardware Co. | 1 |
| Bergner Plumbing, Heat. & Sup. Co. | 2 | Chas. F. Eggers Lumber Co. | 3 | Jackson's Express & Van Co. | 1 | Henry Morgan & Co., Ltd. | 1 |
| Billow Undertaking Co. | 3 | C. R. Elder | 1 | W. K. Jeffries | 1 | Morrison-Skinner Co. | 1 |
| Block & Kuhl Co. | 1 | L. E. Elliott | 1 | Johnson Educator Food Co. | 1 | Motor Transit Co. | 1 |
| J. B. Blood Co. | 1 | Emerick's Motor Bus Line Co. | 6 | Johnson's Express Co. | 1 | Motor Transportation Co., Inc. | 1 |
| Louis H. Bolce Co. | 2 | Emerson Piano House | 1 | Jones Store Co. | 1 | Mountain Auto Line | 1 |
| Booneville Bottling Works | 1 | Factory Oil Co. | 2 | J. G. Justis Co. | 1 | Timothy Murphy | 1 |
| Boston Fresh Tripe Co. | 1 | Marshall Field & Co. | 7 | Kee & Chapell Dairy Co. | 2 | Murta Appleton & Co. | 1 |
| Boston Furniture Co. | 1 | Field & Poorman | 2 | Edward Kelly | 2 | National Plumbing & Heat. Sup. Co. | 2 |
| Bradford Baking Co. | 17 | Fleming Bros. | 1 | Kelly-Springfield Tire Co. | 1 | National Shawmut Bank of Boston | 1 |
| Albert A. Brager | 1 | Florida Motor Transportation Co. | 18 | Kimberly-Clark Co. | 1 | Nelson Farm | 1 |
| Bra-Nola Co. | 1 | Flynn-Froelk Co. | 1 | George C. Kirkhope | 1 | New Bedford Dry Goods Co. | 1 |
| Geo. M. Brice | 1 | W. U. Fogwill | 1 | W. H. Kistler Stationery Co. | 1 | A. J. Norris | 1 |
| Eugene W. Bronecki | 1 | Fort Valley Coca Cola Bottling Co. | 1 | Knickerbocker Storage Co. | 1 | North St. Paul Casket Co. | 1 |
| Buffalo Plumbing Supply Co. | 1 | Alexander Fowler | 1 | Knoble Bros. | 1 | Norwich Motor & Machine Co. | 1 |
| Bullock's | 5 | R. J. Francis Moving Co. | 2 | P. C. Knowlton & Co. | 1 | Town of Norwood | 1 |
| City of Butte | 1 | Frank Franklin | 1 | G. W. Koehler Co. | 1 | V. G. Nottoli | 1 |
| W. L. Byrnes, Inc. | 1 | W. F. Frederick Piano Co. | 2 | Kohlberg Bros. | 1 | O'Neill & Co. | 2 |
| Caine-Grimshaw Co. | 1 | Fries & Schuele Co. | 1 | S. Kohn & Sons Co. | 1 | Orchard & Wilhelm | 1 |
| California Ice Co. | 1 | Fullington Auto Bus Co. | 1 | Kraus Heating & Plumbing Co. | 1 | Ott Hardware Company | 1 |
| Canton Provision Co. | 1 | Chas. Gaffney | 4 | J. S. Kroschewsky | 1 | Oxford Dye Works | 1 |
| H. C. Capwell Co., Inc. | 2 | Gazette Printing Co., Ltd. | 1 | Theodor Kundtz Co. | 4 | Pacific Baking Co. | 1 |
| Carbon Coal Co. | 1 | General Baking Co. | 1 | F. Landon Cartage Co. | 1 | Pacific Fruit & Produce Co. | 2 |
| J. B. Carr Biscuit Co. | 1 | Gifford's Express | 1 | S. Laskau | 1 | E. F. Pahl Co. | 1 |
| Carter-Mullaly Transfer Co. | 1 | Gimbel Bros. | 25 | Lee Bros. Furniture Co. | 1 | Palais Royal | 1 |
| M. Catalano & Sons | 1 | Goodyear Tire & Rubber Co. | 2 | E. Lehnhardt Estate | 2 | G. E. Patteson & Co. | 1 |
| Central Paper Co. | 1 | Grady Hospital | 2 | Lexington Dry Goods Co. | 3 | Pearson Paper Box Co. | 1 |
| Chandler & Rudd Co. | 5 | A. Graham & Son | 2 | City of Lincoln Police Dept. | 1 | Pelletier Co. | 1 |
| City Coal Co. | 1 | Grand Rapids Lumber Co. | 1 | City of Los Angeles Police Dept. | 1 | People's Store Co. | 2 |
| City Ice Co. | 1 | Greenfield Electric Light & Power Co. | 1 | Los Angeles Gas & Elect. Corp. | 1 | Perkinswood Transportation Co. | 1 |
| City of Cleveland, Police Dept. | 3 | Greenfield Transfer Co. | 1 | Walter M. Lowney Co. | 1 | Perrett & Glenny | 2 |
| Cleveland Burial Case Co. | 2 | B. E. Grover | 1 | J. B. Lukens | 1 | Pierson Engineering & Constr. Co. | 1 |
| Cleveland Provision Co. | 7 | Gulf Refining Co. | 1 | E. B. McAlister & Co. | 1 | Postum Cereal Co. | 1 |
| Clover Leaf Dairy Co. | 2 | Fred Gunther Co. | 1 | Peter McCabe | 2 | Portland Damascus Milk Co. | 1 |

# WHITE

# MILEAGE

## 100,000 Miles *and* More

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| W. E. Prouty | 1 | C. Schmidt & Sons Brewing Co. | 1 | Stevens Hardware Co. | 1 | M. Weiland | 1 |
| Puro Ice Cream Co. | 1 | Schulze Baking Co. | 19 | Stewart Taxi-Service Co. | 18 | Weinacker Ice & Fuel Co. | 1 |
| Ramos Bros. | 1 | Schuneman & Evans | 1 | Strouss-Hirshberg Co. | 1 | William Weller | 1 |
| Caradoc Rees | 1 | Schuster & Gormely | 1 | Sturgis Jones Last Co. | 1 | M. F. Westergren, Inc. | 1 |
| Reichman-Crosby Co. | 2 | Scruggs-Vandervoort-Barney | 1 | Telling-Belle Vernon Co. | 2 | West. Canada Flour Mills Co., Ltd. | 1 |
| A. W. Reiser & Co. | 1 | Shaw Transfer Co. | 1 | A. C. Titus & Co., Inc. | 1 | Western Grocers, Ltd. | 1 |
| Reliable Furniture Co. | 1 | Shenberg & Rubinoff | 1 | Tuolumne Lumber Co. | 1 | Western Motor Transfer Co. | 1 |
| Rhodes Bros., Inc. | 1 | Frank Silvers | 1 | J. M. Traxler | 3 | D. J. Whelan Estate | 1 |
| Rocky Mountain Parks Transp. Co. | 2 | Franklin Simon & Co. | 3 | Tucson Cornelia & Gila Bend R. R. | 2 | White Hardware Co. | 1 |
| W. S. Roe | 2 | Smith Bros. & Burdick | 1 | Turner & Westcott | 1 | White Rapid Transit Corp. | 1 |
| Ryan Fruit Co. | 1 | Smith Green Co. | 1 | Twin City Motor Bus Co. | 4 | White Transit Co. | 3 |
| Saks & Co. | 1 | Augustus Snyder | 1 | Union Lumber Co. | 1 | W. M. Whitney & Co. | 3 |
| Arthur H. Sagendorph | 1 | South Bend Wholesale Grocery Co. | 1 | United Cape Cod Cranberry Co. | 3 | Chas F. Wing Co. | 2 |
| St. Paul Daily News | 1 | W. P. Southworth Co. | 1 | United States Army Q. M. C. | 2 | Winzeler Undertaking Co. | 1 |
| Salt Lake Transportation Co. | 3 | J. W. Spooner | 1 | United States Bakery | 4 | Woodward & Lothrop | 1 |
| Samuelson, Florist | 1 | Standard Oil Co. of Ohio | 1 | United States Laundry | 2 | Worcester Baking Co. | 1 |
| County of San Bernardino | 3 | Star Store | 1 | United Transportation Co. | 1 | Zanesville Fruit Co. | 1 |
| Sandusky Furniture Store | 1 | Sterling Products Co. | 3 | Waltham Laundry | 2 | Zettelmeyer Coal Co. | 1 |
| San Joaquin Baking Co. | 1 | Sterling & Welch Co. | 7 | Watkins Bros., Inc. | 1 | Zimmerman Bros. | 1 |
| Santiago Orange Grove Association | 1 | Stern Bros. | 2 | Watson Paint & Glass Co. | 1 | Peter H. Zink | 1 |
| Savage-Schofield Co. | 2 | Steubenville Coal & Mining Co. | 2 | Webster Transportation Co. | 1 | John Zitterbart | 1 |

### 150,000 TO 200,000 MILES

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Acme Furniture Co. | 1 | Dixon Transfer & Storage Co. | 1 | Hudson's Bay Co. | 1 | Reemsnyder Co. | 1 |
| Addison Auto Bus Co. | 1 | East Ohio Gas Co. | 1 | M. L. Hullett | 1 | Mark Regan & Son | 1 |
| Akron Storage and Contracting Co. | 1 | T. Eaton Co., Ltd. | 3 | Hunt Mercantile Co. | 1 | Rocky Mountain Parks Transp. Co. | 1 |
| Atherton-Fowler Furniture Co. | 1 | Eatonville-Tacoma Stage Co. | 1 | Independent School District No. 51 | 1 | Roshek Bros. Co. | 1 |
| C. W. Baker | 1 | Eberhardt-Hayes Music Co. | 1 | Indianapolis Abattoir Co. | 1 | Alvin M. Schoenfeld | 1 |
| Benicia & Vallejo Stage Line | 1 | Chas. F. Eggers Lumber Co. | 1 | Edward Kelly | 1 | Schulze Baking Co. | 3 |
| Berz Co. | 1 | Emerick's Motor Bus Line Co. | 3 | S. Laskau | 2 | Shepherd & Story | 1 |
| Bledsoe Co. | 1 | Florida Motor Transportation Co. | 3 | Lyons Express Co. | 2 | Smith Bros. Motor Truck Co. | 3 |
| Bonwit, Teller & Co. | 2 | Hugo H. Foerster | 2 | M. J. Malloy | 2 | Star Baking Co. | 1 |
| Botzum Bros. Co. | 1 | Foley Auto Delivery Co. | 1 | Massachusetts Baking Co. | 1 | Chas. M. Steiff, Inc. | 1 |
| Boulevard Transportation Co. | 7 | Foster & Kleiser Co. | 1 | Memphis News-Scimitar | 1 | Tacoma Taxicab & Bag. Transf. Co. | 1 |
| Bradford Baking Co. | 9 | William L. Freeman | 1 | C. J. Milligan Co. | 1 | James A. C. Tait & Co. | 1 |
| Chicago Cooperage Co. | 1 | Friends Hospital | 1 | Moran Trucking Co. | 1 | Telling-Belle Vernon Co. | 1 |
| Frank A. Cholewinski | 1 | Fries & Schuele | 1 | Mountain Auto Line | 1 | Thompson & Thompson | 1 |
| Clover Leaf Dairy Co. | 1 | Fuller Dry Cleaning Co. | 1 | J. Mullany & Co. | 1 | Tooke Bros., Ltd. | 1 |
| Coca Cola Bottling Works Co. | 1 | A. Graham & Son | 1 | Muscatine, Burlington & So. R. R. | 1 | 20th Century Heating & Vent. Co. | 1 |
| Columbus Transfer Co. | 5 | Hale Auto Corp. | 1 | M. O'Neil Co. | 1 | Twin City Motor Bus Co. | 3 |
| Conrad-Baisch-Kroehle Co. | 1 | Hardy Furniture Co. | 1 | Orchard & Wilhelm | 1 | United Home Dressed Meat Co. | 1 |
| Constance Lumber Co. | 1 | Charles E. Harris | 1 | Pacific Coast Biscuit Co. | 1 | United Transportation Co. | 2 |
| Cowlitz & Chehalis R. R. Co. | 1 | Highway Transit Co. | 2 | J. A. Poole | 1 | White Rapid Transit Corp. | 1 |
| Denecke Co. | 1 | Holt Stage Line Co. | 1 | G. F. Reed & Son | 1 | White Transit Co. | 1 |
| Denholm & McKay | 1 | | | | | Woodlawn Imp. Assn. Transp. Corp. | 2 |

### 200,000 TO 300,000 MILES

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Armour & Company | 2 | Florida Motor Transportation Co. | 2 | McLaughlin Transfer Co. | 2 | T. S. Reed Grocery Co. | 1 |
| Atlantic Refining Co. | 1 | Fowler, Dick & Walker | 1 | McMahon Transportation Co. | 2 | G. F. Reed & Son | 1 |
| Austin Motor Transportation Co. | 1 | Fuller Dry Cleaning Co. | 2 | Madera-Fresno Stage Co. | 2 | W. S. Roe | 1 |
| Baum's Home of Flowers, Inc. | 1 | Fullington Auto Bus Co. | 1 | Malandre Bros. | 1 | Alvin M. Schoenfeld | 1 |
| A. E. Berry, | 1 | Hansen Motor Trucking Co. | 1 | Maryland Transportation Co. | 4 | Arlington Setzer | 1 |
| Bonwit, Teller & Co. | 3 | Harper Garage Co. | 1 | Mendham Garage Co. | 2 | Shepherd & Story | 1 |
| Bower Transportation Co. | 1 | W. J. Hay Co. | 1 | Mesaba Transportation Co. | 2 | Smith Brothers Motor Truck Co. | 1 |
| Broadway Taxi Operating Co. | 8 | Higbee Co. | 2 | Mountain Auto Line | 1 | W. P. Southworth Co. | 1 |
| Burns & Campbell Co. | 1 | Highway Transit Co. | 2 | Ocean County Coal Co. | 1 | Tri-State Telephone & Telegraph Co. | 1 |
| California Ink Company, | 2 | Holt Stage Line Co. | 2 | Pacific Brewing & Malting Co. | 1 | Tuscola Produce Co. | 1 |
| George M. Cooley Co. | 1 | Huddleston Park | 1 | Frank M. Pauli | 1 | Twin City Motor Bus Co. | 3 |
| A. Dumani, Ltd. | 1 | Hudson's Bay Co. | 1 | E. C. Petrie | 1 | Warner & Company | 1 |
| Eatonville-Tacoma Stage Co. | 1 | M. L. Hullett | 1 | Phelps-Dodge Corporation | 1 | Westfield Laundry Co. | 1 |
| Emerick's Motor Bus Line Co. | 6 | Kirchners | 2 | | | White Transit Co. | 9 |

### 300,000 MILES AND MORE

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Alexander & Walling | 1 | Columbus Bread Company | 2 | Humptulips Logging Co. | 1 | Alvin M. Schoenfeld | 1 |
| Artesian Well & Supply Co. | 1 | Fuller Dry Cleaning Co. | 2 | N. S. Koos & Sons | 1 | Tacoma Transit Co. | 4 |
| Frank Bird Transfer Co. | 7 | Hancock Bros. Fruit Co. | 2 | Madera-Fresno Stage Co. | 3 | Thompson & Thompson | 1 |
| Bower Transportation Co. | 1 | | | | | Wouters Laundry | 1 |

THE WHITE COMPANY, *Cleveland*

# TRUCKS

THE SCIENTIFIC AMERICAN, November 13, 1920. Volume 123, Number 20. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year.
Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

# Which of these salesmen will get in?

*ANSWERING this question, a prominent buyer said, "Nowadays I must divide salesmen into two classes, first, those who call to get something, and second, those who come to contribute something. It is hard to turn away the latter kind who bring information and service helpful to me."*

The word "Salesmanship" does not fully express the work that such men do. Their function is bigger than that.

The salesman who can contribute to the cause of fire prevention or the reduction of up-keep cost by skillful advice as to a properly constructed Johns-Manville Asbestos Roof is not a salesman only, for his work is more than commercial—it is economic.

The Johns-Manville man who can show a saving:—maybe thousands of dollars in fuel; a reduction in plant maintenance, or by preventing a shut down on a much needed boiler, makes the order he gets merely an incident to a greater purpose.

So, Johns-Manville waste killers have a real job. They must combine with a willingness to serve a wide experience and a thorough knowledge of those Johns-Manville materials which promote the cause of conservation everywhere by cutting fuel and power losses, preventing property losses and saving time and money.

It may be that some day a Johns-Manville man's card will come to your desk. Use the opportunity to let him show you how he can help you.

Let him tell you something of how his company serves and protects its customers. Let him explain how it has insured the quality of its products by the highest manufacturing standards, rigidly maintained, how it believes in its men and, because to you they are Johns-Manville, how it expects them to live up to its standards in all they do.

JOHNS-MANVILLE SERVICE COVERS THE CONTINENT

*Through—*

**Asbestos**

**and its allied products**

**INSULATION**
*that keeps the heat where it belongs*
**CEMENTS**
*that make boiler walls leak-proof*
**ROOFINGS**
*that cut down fire risks*
**PACKINGS**
*that save power waste*
**LININGS**
*that make brakes safe*
**FIRE PREVENTION PRODUCTS**

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*10 Factories—Branches in 64 Large Cities*
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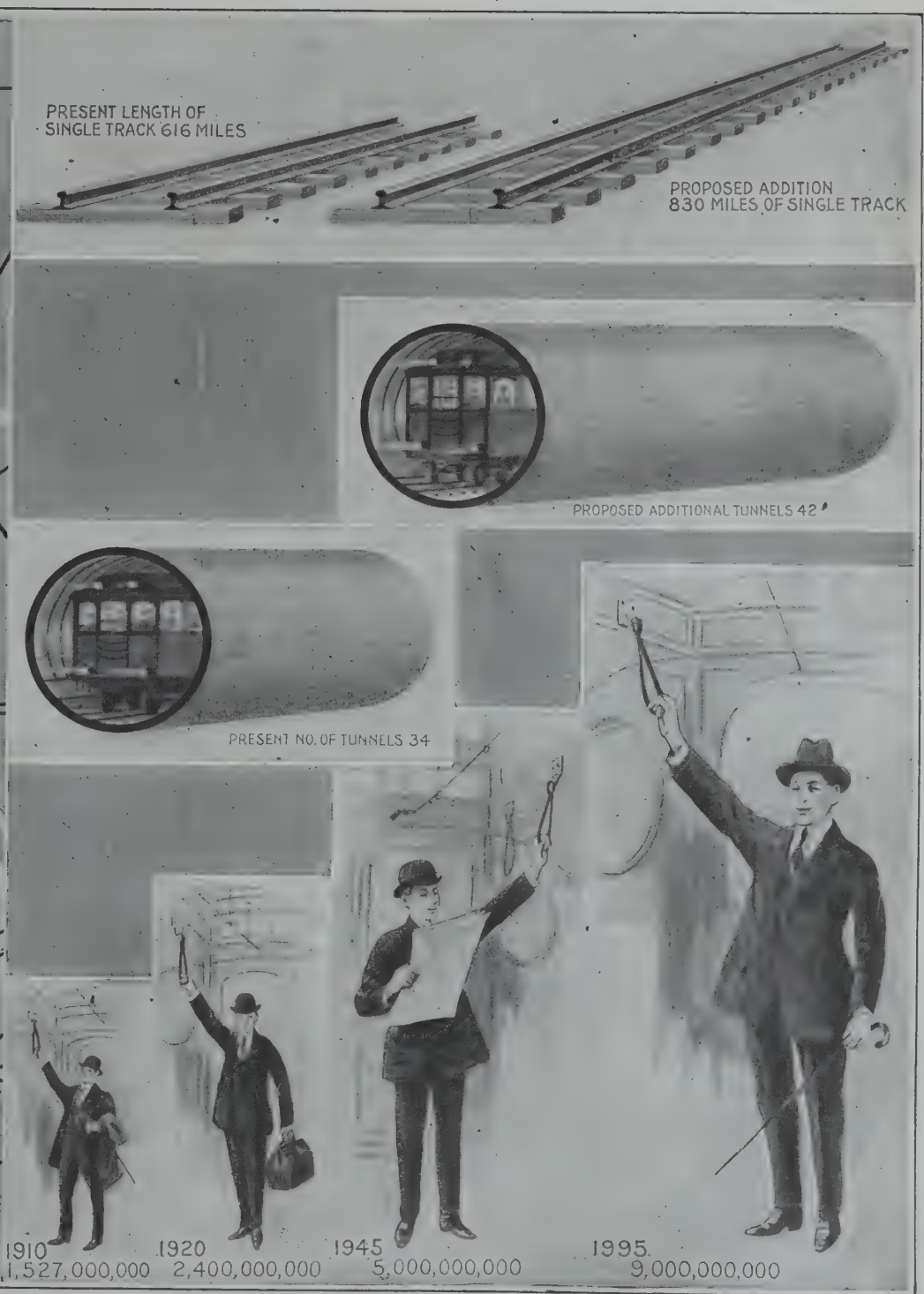
# JOHNS-MANVILLE
## Serves in Conservation

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 20 ] NEW YORK, NOVEMBER 13, 1920 [ 15 CENTS A COPY 20 CENTS IN CANADA




Map of lower Manhattan, showing in black lines the new subways which must be progressively built, in addition to the existing subways (not shown on map) if we are to keep pace with the growth of travel during the next 75 years. The construction to cover the needs of the next 25 years includes four tracks of a double deck, 8-track subway under Eighth Avenue, four tracks of a 6-track subway under Madison Avenue, crosstown moving platforms under 14th, 42d and 57th Streets, and additional tunnels under the East River at Ann Street, Maiden Lane, The Battery and 23d Street and the Narrows. The trunk lines on Third, Ninth and Tenth Avenues, with their branches, and the additional tunnels to Brooklyn, Staten Island and Jersey City, with numerous extensions to the city line, will be completed in the period 1945 to 1995. The drawings to the right show the estimated future subway travel, in passengers per year, and the tracks and tunnels that must be built to meet it during the next 75 years.

**ADDITIONAL RAPID TRANSIT LINES REQUIRED TO CARRY THE POPULATION OF NEW YORK IN 1995.**—(See page 500)

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## In Justice to the War Department

IN considering the storm of criticism which broke upon the War Department on the eve of the recent election, the attitude of the SCIENTIFIC AMERICAN is of course strictly non-partisan. The subject interests us only on its technical side, and for the reason that during the war and at the armistice we dealt very freely with the matter of military equipment.

The charge that in the raising of our huge army and providing it with adequate equipment the Department was guilty of wholesale extravagance and wastefulness, we do not consider to be well-founded. Had our authorities possessed the prophetic vision of a Hebraic seer; had they been able to predict that on November 11th of the year following that upon which we declared war, the great German army would fall like a pack of cards; the scale upon which we enlisted our young men and provided the clothing, food, rifles, machine guns, field guns, heavy artillery, powder supplies and all the equipment and impedimenta of war, would have been extravagant and wasteful to the *nth* degree.

But lacking such prophetic vision, the War Department had to base its estimates upon the military conditions as they existed in the spring of 1917, when the enemy was at the very crest of his military achievement. What were those conditions? Servia was under his heel; Roumania, too. Russia had crumbled, and the whole defensive line of the Central Powers was intact and apparently unbreakable. Moreover, the most optimistic of the high commanding officers of our allies were agreed that the war would last through the season of 1919; while there were not a few who believed that the final blow could not be struck before 1920.

Are we now to blame the War Department because it acted in accordance with the existing conditions and planned for recruitment and supplies upon a scale proportionate to the immensity of the undertaking? And yet this is exactly what the recent critics of the War Department have been doing; and, in our opinion, the whole proceeding has been as unjust as it has been ungenerous.

True it is that at the armistice we found ourselves with enormous plants for the production of guns, powder, et cetera, that were as yet in an incomplete condition. True it is that the fruits of all our preparatory labor were only then beginning to reach the western front in quantity. But true it is, also, that had the war stretched on into 1919, our rapidly increasing armies at the front would have been supplied with every war necessity upon such a generous scale that the surplus which existed at the armistice would have been fully consumed.

It is unquestionable that the enormous extent of our preparations for 1919 went a long way toward causing the German army to get cold feet in 1918. Moreover, in all fairness, we should remember that the War Department bent its energies so ably to the solution of the sudden emergency presented by the German collapse, that it was able to realize over 4½ billion dollars by the sale of surplus supplies and the settling of claims.

No. The outstanding lesson of this whole matter is that those among us, who, like General Wood, worked day in and day out to urge upon Congress the necessity for preparedness, have received in this matter a tremendous endorsement of their policy. The War Department made mistakes, of course. Who does not? But had their program of 1917 been absolutely flawless, the 25 billions of dollars' indebtedness that is upon us today would have been but slightly reduced. Had we on the other hand but listened to the voice of Wood in 1914 and 1915, the Germans would have asked for an armistice at least one and possibly two years sooner than they did, and it is certain that our present war expenses and those of our allies would have been cut in half.

## A Stupendous Rapid-Transit Problem

UNQUESTIONABLY, the most pressing engineering problem of the day in New York City is to provide adequate rapid transit facilities, not alone for the present population but for the teeming millions which are being added to the city at a rate which steadily accelerates year by year.

The ideal topography for meeting such conditions would be that in which the various lines of travel were able to radiate in all directions freely and without any physical obstacles to prevent the construction of subways, elevated roads and street car lines. Instances of these conditions are to be found in London, Paris and Berlin, where the rivers upon which the cities are situated are so narrow as to afford but slight obstacles to the construction of bridges and tunnels. The business center of New York, however, is situated on the lower half of Manhattan Island, which, with an average width of less than two miles, extends north and south for a distance of ten miles and is hemmed in by the deep and broad East and North Rivers, the former necessitating bridges with a clear span of 1,500 to 1,600 feet and the latter calling for a clear span of the unprecedented length of 3,000 feet and over.

Modern developments in civil and electrical engineering have made possible the crossing of these natural obstacles by the alternative method of tunneling. The Greathead shield and electric traction have brought the cost of tunnel construction and operation within practicable limits, although the crossing by bridge still remains, and always will, a far more economical method when compared on the basis of cost per single track; and it has, of course, the advantage of being a more pleasant mode of travel from the viewpoint of the passenger.

The configuration of Manhattan, which is today and always will be the commercial hub of our great city, greatly complicates the problem of providing rapid transit service, for the reason that the natural flow of traffic is north and south through the avenues, and in the early years of the history of transportation, we find that the bulk of the travel moved in these directions. Even in the future, when the North and East Rivers shall have been crossed by a multiplicity of bridges and tunnels, the city will be at a disadvantage as compared with those having a radial system of distribution, because of the fact that rapid transit to the south and southwest is hindered by the broad waters of New York Bay. In a city like Paris, having a free radial distribution, the territory served increases as the square of the distance from the city center, whereas in Manhattan it increases directly as the distance.

We invite the citizens of New York to make a careful study of the present and future problem of transportation in their city as portrayed in the map and diagrams on the front page of this issue and as described in the article on page 500. The engineers and the Transit Construction Commission are to be congratulated upon their foresight in making such a comprehensive study of this problem and presenting it for public consideration. Easy it is to be wise after the event; but, as the history of municipal improvements has shown, it is very difficult to teach the public wisdom before the event—the wisdom of judicious foresight and preparation. No one can study the statistics which are here presented without realizing that unless the city fathers hasten the completion of the present subways, and act upon the proposed plans to take care of the increase in travel for the next twenty-five years, we shall sooner or later, and rather sooner than later, find ourselves confronted with a congestion of travel which would be little short of a public calamity.

In justification of the above warning, and having in mind the frightful jam which occurs in the rush hours even today, we invite attention to the fact that from 1910 to 1920 rapid transit travel on all lines increased, roughly, from 1½ billion passengers per year to about 2½ billion, and that within the next twenty-five years these figures will have doubled to 5 billion passengers, and fifty years later or by the end of the century, there will be an annual travel of some 9 billion passengers.

## The Naval Experimental Laboratory

THE new naval laboratory for which Congress has appropriated $2,000,000, owes its inception to the Naval Consulting Board. It will be remembered that one of the first recommendations of this body was the building of a large and thoroughly equipped laboratory in which promising inventions could be investigated and rejected or developed, as the case might be, on a scale and with a completeness which existing conditions in the Navy Department rendered impossible. In furtherance of this scheme a committee of the Board, composed of men who were expert in laboratory work, was appointed to formulate a general plane and select a site. For various reasons, they reported to the Board in favor of Annapolis; but in the discussion which followed some diversity of opinion developed, notably in the case of Mr. Edison, who was strongly in favor of New York.

This took place after 1914 and before our entrance into the European war. The rush of our preparation for that great conflict and the multiplicity of larger problems that developed, coupled with the fact that there was an offer to the Government of many private and well-appointed laboratories, caused the subject to be dropped for the time being. It should be mentioned, however, that the choice of Annapolis was favored by naval officers, who pointed out that the Government had already established an experimental laboratory at that location, which had cost about $600,000, and that there was ample land for expansion of the plant. Also it was urged very strongly that the work of the laboratory be coördinated with that of the Naval Academy, and particularly with the work of the postgraduate school, which, by the way, has been opened up again since the war, and is to be greatly expanded. The point was made that an adequate experimental and research laboratory at the naval college would enable the student officers to do special research work, and that the experts of the laboratory might be employed as lecturers at the postgraduate school. In the minds of many naval officers this was the strongest of all considerations.

However, the laboratory committee, after giving due wieght to the opinion of naval officers, has finally decided against Annapolis, and in favor of a site at Bellevue, a naval reservation near Glesboro Point on the Potomac and lying in the District of Columbia. The site is opposite and about one mile distant from the War College at Washington.

The principal considerations which led to the choice of the Washington site are first, the desirability of locating the laboratory as near as possible to the Bureau of Standards, with which institution the work of the laboratory must necessarily be carried on in close and continual coöperation. Secondly, it was considered desirable that the laboratory should be built within easy reach of the various naval bureaus, particularly those of Construction and Repair, Steam Engineering and Ordnance. Another consideration was that of assuring the future finances of the institution, which would have to come in the form of appropriations from Congress. Laboratory work and plant is frequently difficult to explain to the lay mind. If the laboratory were located within half an hour's automobile ride from the Capitol, it would be possible to take the committee down and show them work which was being done and explain on the spot why the requisite appropriations were necessary. A final reason and alas, perhaps the most important of all, was that by locating the laboratory in the District of Columbia, whose residents have no vote, it would insure that the financial prosperity of the institution would not depend upon those familiar tactics known under the name of "log-rolling." If Congressmen had no particular political object to further by giving or withholding appropriations, it was realized that the prospects of the claims of the laboratory obtaining just and unbiased consideration would be greatly enhanced.

## Engineering

**Nicaragua's Highways,** according to the American Consul, are the rivers and lagoons. There is not a mile of road anywhere in the Bluefields district. However, the fact that the Nicaraguan Government appropriated $250,000 out of the national revenues of the Republic for the construction of certain automobile highways seems to indicate that the beginnings of a definite plan for such construction have been made. During 1919 three automobile roads approximating 200 miles were under construction, as follows: From Porto Dias to La Libertad, from Managua to Matagalpa, and from Montagalpa to the Pacific Coast.

**Cement-Lined Service Pipes.**—Among other economies introduced in the waterworks department of Lynn, Mass., whereby that town was able to offset advances in prices and wages and maintain the water supply at the old figure, was the substitution of cement-lined pipe for an expensive type of lined pipe which did not stand up very satisfactorily with Lynn water. To prevent the breaking of the lining with ordinary pipe-cutters, all pipe was cut in the shop to fit the requirements by the use of a metal cutting machine, which, on a test with a single blade, cut 140 ⅛-inch disks from a piece of 1-inch lined pipe without breaking the cement. To prevent exposed threads in connections, malleable iron countersunk fittings are used, which are lined in the shop with lead, leaving only six threads unlined. When this lining comes in contact with the cement lining of the pipe it makes a snug fit without danger of crushing the latter.

**The Hudson Bay Railway.**—Agitation is being renewed in western Canada for the resumption of work on the Hudson Bay Railway, now needing only 92 miles of construction to complete a short cut across the narrow end of the globe, reducing the distance from Calgary to Liverpool by about 1,350 miles. The deep-water development of the harbor at Port Nelson, consisting of an artificially constructed island, situated near the outer edge of the tidal flats, about two-thirds of a mile from shore, connected with the mainland by a bridge of seventeen spans, has created some opposition to those who favored Port Churchill for the railway terminus. The island as built is now one-half mile in length and enclosed on all but the deep-water face by timber crib retaining works, and the interior has been partly filled with material dredged from the site of the deep-water wharves and channel. The work was greatly interfered with on account of the war.

**The Use of Compressed Gas.**—It appears as though all progressive countries are making extensive use of compressed gas for various purposes. Argentine Republic, for instance, is manufacturing and compressing gas locally and the output of the factories is used by the entire country. The machinery for its manufacture was originally imported from France and Germany. Compressed gases are used in Canada, in connection with industrial establishments and hospitals. Importation is made in large cylinders, the gas being repumped into smaller ones for distribution. The gases come from the United States. In India compressed gases are generally used by the principal engineering, shipping, dock, and railway concerns for welding and cutting metal; also in many of the hospitals. The gases are of local manufacture. In Sweden compressed gases are being used extensively for welding. Shipyards and large shops produce the gas in their own plants instead of buying cylinders with compressed gas. Machinery for the production of compressed gas was formerly obtained in Germany and France, but Sweden now supplies its own markets.

**Building Blocks from Clinkers.**—A local enterprise of Brest, France, which suspended operation during the war has recommended the production of building blocks that are gaining widespread usage in the Brest district in certain kinds of building construction. The blocks are made in molds as are cement building blocks in the United States. The materials used are sand, lime, and cement, with a base of crushed coal clinkers. The lower grade of blocks also contain some coal cinders. These blocks are made in several sizes. The size 10 by 20 by 6 inches sells for 237 francs per hundred blocks. The clinker building blocks are particularly used in pavements, walls, floors of cellars, warehouses, stables, garages, rough buildings and small residences. The blocks have the advantage over brick for building material in that they are cheaper and facilitate quick construction. They take plaster on the interior and stucco on the exterior where it is desirable in buildings. However, the outstanding advantage of the clinker block over the brick in the Brest district is the capacity of the former to withstand the great humidity of the climate that causes brick walls to drip water in the interior of the houses.

## Science

**Dust Hazard in Wet Grinding.**—The Public Health Service has published a report by Messrs. Winslow and Greenburg on the dust content of the air in the grinding rooms of a large Connecticut factory, where wet grinding is the rule. This process is generally supposed to be relatively harmless to the workman. In the case examined, however, the air was found to contain, on an average, 15,800,000, and in one sample 50,000,000 particles, mostly 1 or 2 microns in diameter, per cubic foot. The dangerous condition thus indicated is confirmed by the fact that the tuberculosis death rate among the operatives is ten times that of the general population. In order to facilitate rapid work, the grinders are tempted to cut down the amount of water supplied to the wheel, and in grinding a heavy object like an ax upon a wheel of soft natural sandstone the worker presses so heavily upon the wheel that the superficial layer of water is pushed back behind the ax and the outer surface of moist stone is ground off, exposing a dry surface, which, in its turn, is abraded and discharged as atmospheric dust. In view of these conditions, it would be a benefit to the workers to substitute dry grinding, with an efficient exhaust system.

**How Do Raindrops Form?**—The stereotyped explanation of the formation of raindrops contains some rather striking fallacies. It is assumed that when air is cooled below the dew-point condensation occurs on the nuclei present; that the larger droplets, owing to their lesser vapor tension, grow at the expense of the smaller; and that the larger and more rapidly falling drops coalesce with others on their downward path to form full-sized raindrops. Dr. W. J. Humphreys, who dealt with this subject at the last meeting of the American Physical Society, pointed out that the number of condensation nuclei in a given volume of air is ordinarily so great that the amount of moisture present could not form drops as large as raindrops around them. In fact, the available space would not hold as many raindrops as there are nuclei. It is true that the larger drops do grow at the expense of the smaller, but according to theory, at a rate far too slow to be effective in the process of rain production. Lastly, even if a droplet should fall quite through a cloud layer and actually coalesce with all the particles in its path, the chance of its thus becoming a full-sized raindrop would be very small. Dr. Humphreys explains rain formation thus: Humid air ascends and forms cloud droplets on the nuclei present as soon as the air cools below the dew-point. The drops in the lower part of the cloud thus formed filter out most of the nuclei from the air ascending still higher. Thus at upper levels there are so few nuclei that a drop of "falling" size can form around each of them. These drops doubtless often grow larger through coalescence with other drops during their fall. The last process is facilitated by the electric charge which the drops usually have.

**The Uses of Helium.**—The production of helium on an extensive scale which began during the war, when it was proposed to use this gas for filling balloons and dirigibles, has led to considerable discussion as to other ways in which helium can be used. Prof. J. C. McLennan deals at length with this question in a lecture, published in *Nature*. It appears, in the first place, that if helium is used for filling airships the supply from the British Empire would be far from adequate for the British air fleet. One way of economizing it, would be to use it only in compartments adjacent to the engines. As to various industrial uses, it may be used as a filling for thermionic amplifying valves of the ionization type; also for filling tungsten incandescent lamps, especially for signal purposes where rapid dimming is essential, and for producing gas arc lamps in which tungsten terminals are used. Some objections to these uses are pointed out. Nutting has shown that Geissler tubes filled with helium are very suitable, under certain conditions, for light standards in spectrophotometry. Helium is also invaluable in spectroscopy, and for various other laboratory uses. Elihu Thomson has suggested that if divers were supplied with a mixture of oxygen and helium, the rate of expulsion of carbon dioxide from the lungs might be increased, and thus the period of submergence might be considerably lengthened. The widest application of helium, however, appears to be in the field of low temperature research, as liquid helium—and perhaps eventually solid helium—enables one to reach the lowest temperatures attainable by any means. A point of special importance to which Professor McLennan calls attention is that the supplies of natural gas from which helium can be extracted are being rapidly used up; hence it might be well to store a supply of this gas for use in years to come.

## Industrial Efficiency

**Shoes from Mud Shark Skins.**—Fancy footwear and other novelties are to be manufactured by a company of Victoria, B. C., from the skins of mud sharks. Operations are now under way. The company has been granted an exclusive license to fish for mud sharks in the Gulf of Georgia.

**France's Steel Industry.**—Steel manufacturers and merchants throughout France are all of the some opinion—that the present demand in France for foreign steel products, including plates, sheets, beams, sections, channels, wire rods, tubes, and angles for railway car construction will continue for at least a year. No home-made plate is available for the independent shipbuilding plants. Such ship plate as is now produced passes directly from the mills to shipyards in which the mills are financially interested. It is said that by this month only 25 per cent of the mills are operating, due to the shortage of materials.

**Paper Pulp from Congo.**—Papyrus, which grows in great abundance near Elizabethville, in the Belgian Congo, principally along the lower Lualaba, near the lakes of Kabuli, Sjemba, Kisali, and Neaga, is to be exploited by a large company which has been granted a concession. It is planned to establish near the river a large plant, costing two and a half million francs, which will have an initial production of 20,000 tons of pulp. The material for this factory is to be sought among the Belgian, and, if necessary, allied manufacturers. The papyrus of the Congo has shown on analysis to contain 37.8 per cent cellulose. After research and experiments, a process was discovered for bleaching the plant.

**The Pigment Deposits.**—The discovery of an extensive deposit of ocher and sienna at no great distance from the surface and within 30 miles of Adelaide, South Australia, has attracted much local interest, particularly in view of the abnormally high price of imported paint pigments. Though regarded primarily as a mining proposition, the discovery is important in a manufacturing sense. During the years of war several new paint works were established in Australia, but the promoters were handicapped to some extent by the necessity of importing most of the requisite raw materials. This new find of ocher and sienna therefore extends the possibilities of the paint industry and should render it largely independent of overseas supplies of the basic pigments.

**Peat as Locomotive Fuel.**—Interesting trials to test the possibilities of peat as fuel for locomotives have been in progress for some months on several railroads in Sweden. The reports so far show favorable results. One privately owned railroad in southern Sweden, 256 miles in length, has found peat so practical for steam purposes that the management believes the road can dispense entirely with coal. The State railways have likewise been testing peat for steam purposes, with good results, and have on a limited scale adopted it for fuel. For some years the State railways have been operating a factory for the production of peat powder, which is said to be an excellent fuel. In Sweden, where there are 10,000,000 acres of peat bogs, with an average depth of 6.6 feet, the substitution of peat for coal would add enormously to the national wealth. Every acre of peat bog yields nearly 1,000 tons of prepared peat.

**America's Option on German Chemical Drugs.**—The Reparation Commission has offered to the United States Government the right to participate in the purchase of certain chemical drugs from stocks impounded in Germany as well as from the subsequent production of German manufacturers, rendered available to the Commission by the Treaty of Versailles. From the records in possession of the War Trade Board Section it would appear that practically all these chemical drugs are now being manufactured in the United States and are available to the American consumer on reasonable terms as to price, quality, and production. Reliable reports indicate that the domestic product is equal to the German in quality; that the average price is substantially the same as that asked by the German manufacturers for stocks of current production; and that these drugs are manufactured in this country in quantity sufficient to meet all indicated domestic demand. The foregoing covers not only synthetic organics of commerce, but likewise practically all of the German patented products. For this reason this Government does not feel it advisable to take active steps to place upon the market foreign-made drugs which would compete with those of domestic manufacture, and, therefore, will not exercise its option upon impounded stocks of chemical drugs of German manufacture or upon stocks of chemical drugs manufactured during the months January, 1920, to June, 1920, inclusive.

# The State and the Farmer

## Successful Development of the California Land Settlement Scheme

By H. A. Crafts

Levelling and checking land for California's experiment in directed semi-cooperative farming

*THE United States, as is clearly shown by so much of the 1920 census returns as has been made public, still suffers from the tendency of the rural population to gravitate toward the city. Ways and means of meeting this situation and insuring that we shall have left enough producers of food to feed the nation are becoming more essential every year. One way is to make it easier for the small farmer to acquire title to the land which he works, and to aid him in the successful cultivation of that land. This sounds like the cooperative schemes which have failed with such singular unanimity wherever they have been tried; that it does not necessarily involve the weak elements leading toward such failures must be concluded from the great success which has attended the California Land Settlement scheme. What this is and how it has worked Mr. Crafts tells us in this story.*—THE EDITOR.

THE California State Land Settlement Scheme at Durham, Butte County, was launched in 1918, and is the first settlement of the kind to be established in the United States.

A tract of 6,219 acres of farm land purchased by the State was subdivided into small farms, ranging in size from two to one hundred and fifty acres.

The spirit in which the colony was started is best indicated by the enabling act adopted by the California State Legislature in 1917, which contains the following clause:

"The Legislature believes that land settlement is a problem of great importance to the welfare of all the people of the State of California, and for that reason through this particular act endeavors to improve the general economic and social conditions of agricultural settlers within the State, and of the people of the State in general."

By provisions of this act the Legislature appropriated the sum of $260,000, of which $250,000 was constituted a revolving fund for the purpose of purchasing and improving farm lands to be sold in turn to bona fide settlers.

The land purchased for this first settlement was a part of the old Senator Leland Stanford estate and with the exception of about one thousand acres is composed of deep, rich alluvial land, lying along the shores of Butte Creek.

Under two allotments and sale in 1918 the entire tract was quickly disposed of, and provided beautiful and productive homes for 120 families, including 200 children.

The enterprise is not of an eleemosynary character, but one designed to help real farmers, possessing real capital, to accomplish better results in the way of practical agriculture. The State Land Settlement Board, a body consisting of five members appointed by the Governor of the State, exercised great pains in allotting the settlement-farms to desirable purchasers. Due consideration was taken of moral character, practical farm experience and financial standing, with a view of welding the settlement into a permanent and prosperous community.

The cost of the land to the Board was $100 per acre for that portion which was susceptible of irrigation, and $10 per acre for that portion that was non-irrigable. Of the latter there were only about 700 acres. This land in turn was sold to settlers at an average price of $150 per acre, and the total price of farm units ranged from $3,600 to $15,000.

The terms of sale to settlers included a cash payment of five per cent of the purchase price, with deferred payments extending over a period of forty years, at five per cent interest. Loans were extended for farm houses and other permanent improvements up to sixty per cent of their cost with twenty years for repayment. No loan for this purpose was made above $3,000.

Very wisely the State Land Settlement Board took cognizance of the vexed question of farm labor and provided for the allotment of two-acre tracts for this class of settlers. These lots were eagerly taken. The initial payment on each lot was less than $20, and deferred payments were arranged on the same basis as those made to farm settlers.

This arrangement was made with a double purpose—that of providing the settlement with a permanent supply of farm help and also of raising the standard of general farm help to a higher level.

The farm laborers of the settlement were enabled to earn from $2.50 to $3.50 per day, with board, or $4.50 without board. Carpenters were paid $5.25 per day of eight hours and were enabled to improve their allotments outside of the working hours.

These settlement farm laborers have the option of either working inside or outside of the colony. They are permitted, as soon as they are financially competent, to purchase larger farms, and thus become proprietary or employing farmers.

The offices of the California State Land Settlement Board do not cease with the mere buying and selling of this land, leaving the settlers to shift for themselves. The most important work comes after the settlers have selected farms and have begun the arduous task of producing a revenue that will enable them to pay for and equip their new homes.

The Board does all in its power to guide the collective work of the settlement along safe lines, supplying farm advisers, farmstead engineers and other experts to help the good work along. It is the plan of the Board to assist the settlement in welding itself into a successful coöperative community, and to inaugurate a system of the most scientific and up-to-date cultural and administrative methods.

At the very outset the Durham settlers organized a Coöperative Stock Breeders' Association. This was done with the prime object of making the settlement the home of pure-bred live stock. The Board inculcated the idea of uniform selection of breeds so that there should be no untoward mixing of blood.

It was agreed that there should be but one or two breeds of cattle, sheep and hogs in the association. For cattle the Holstein was adopted as the type for dairy stock, and short horns for beef purposes. Duroc Jerseys were selected as the desirable type of hogs, and the Romney Marsh and Rambouillet for the sheep breeds. The executive committee of the Settlement Coöperative Live Stock Association has done nearly all the buying of live stock for the settlers thus simplifying and expediting matters.

Instead of leaving each of the 120 families, composing the settlement, to buy material, find workmen and secure designs for their dwellings and farm buildings the Board took it upon itself to lend a most welcome helping hand. It aided the settlers in their purchase of fencing material, cement, lumber, pipe, etc., in carload lots, thus saving the new farmers much labor trouble and insuring them the best of material at lowest prices.

The plans for the new farm houses and their proper location on the respective farms were worked out with much care by the farmstead engineer under the eye of the farmer and his wife and in coöperation with them. In fact all the important

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A typical farm-house erected under State aid in the Durham settlement

Digging trenches for concrete irrigation pipe lines at Durham

*Right:* Sailboats bringing wood for fuel down the river to Washington, D. C., in anticipation of the coming cold weather. *Left:* Unloading cordwood at the municipal wood yard at Knoxville, Tenn. About 135 cords are shown in this pile.

**The farm woodlots kept many nome fires burning during the fuel shortage of 1918. Will history repeat itself this winter?**

## Winter Fuel from Our Woodlands

**By Arthur L. Dahl**

WHETHER or not there will be a shortage of fuel in our cities and towns this winter will depend upon economic conditions, for congested railroad traffic or another strike in the coal regions will soon result in making many people shiver at the icy blasts of winter, for storage stocks are inadequate almost everywhere. Coal is almost the universal fuel for heating in the home, for oil is only used in the larger apartments, hotels and public buildings providing steam heat. When coal is obtainable, it is undoubtedly the most satisfactory, but when the supply is short our thoughts turn to the fuel of Lincoln's day, and we would give a lot for some of the split rails that helped him earn a meager living.

The farm woodlots during the fuel shortage of 1918 enabled many of the home fires to be kept burning, for thousands of cords were then cut and hauled into nearby towns to take the place of coal, not only for heating the home but often to keep the wheels of industry moving.

Two pounds of seasoned wood have a fuel value equal to one pound of coal, and while different kinds of wood have different fuel values, generally, the greater the dry weight of a non-resinous wood the more heat it will give out when burned. A cord of hickory, oak, beech, birch, maple, locust or cherry, weighing about 4,000 pounds, is equal to one ton of coal. Other species, having less heat value, such as hemlock, red gum, sycamore or shortleaf pine, require a cord and a half to equal a ton of coal. Two cords of such woods as cedar, redwood, poplar, cypress, spruce and white pine are needed to equal the heat value of a ton of coal. Resinous woods have a greater heat value per pound than non-resinous woods, and this increased value varies with the resin content. The available heat value of wood likewise depends upon the amount of moisture present. With green wood much of the heat it is capable of giving is used up in evaporating the water.

Woods have different characteristics in burning, some furnishing a quick, intense heat, while others will burn slowly and evenly. Hickory, of the non-resinous woods, has the highest fuel value per unit volume of wood, and it burns evenly, and holds the heat. Oaks, beech, birch, and maple have somewhat the same qualities, in varying degrees, while the white pines have a relatively low heat value per unit volume, but they ignite readily and give out a quick hot flame, but do not last long. Woods containing lots of resin, although giving an intense heat, give out a large volume of oily black smoke that is often objectionable around the home.

Under normal conditions the United States use about one hundred million cords of wood annually for fuel, of which about 80 per cent is consumed in the rural districts. In spite of the fact that most of our farm woodlands occur in the 17 States making up New England and the Lake States, the farmers and rural population of this section annually use in excess of 18,000,000 tons of coal. If by substituting wood one-quarter less coal could be burned on farms and one-tenth less in villages, the total saving would amount to nearly 3,000,000 tons, or between 65,000 and 70,000 carloads.

Wood, being a bulky and heavy commodity, does not justify shipment for very long distances by rail, but where water transportation is available, considerable cord wood finds its way to the urban markets, for loaded on flats or rafts, a large quantity can be transported at slight expense. Accordingly, along most of our waterways cordwood is one of the articles of commerce, especially when a coal shortage creates an unusual demand for fuel wood.

The development of power farming has resulted in increasing the amount of marketable products from farm woodlots, for in the early days it was necessary to cut up the tree trunks with a hand axe, a slow and arduous undertaking, and few farmers thought the returns were adequate. With the modern tractor, however, to furnish belt power for a small portable saw outfit, it is possible to cut up in a few days a considerable quantity of timber, and farmers owning tractors are more and more getting into the habit of cutting up the dead and down timber and of thinning out their woodlands.

The matter of supplying cordwood from our farms is entirely an economic one. While there are some 143,392,000 acres of woodland on the farms in the

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## Forewarnings About Forest Fires

**By G. H. Dacy**

UNCLE SAM, woodsman de luxe, has over 154,000,000 acres of national forest to maintain, improve and guide and guard against fire losses. Destructive conflagrations are the most insidious and insistent foes which the Government has to combat in its efforts to conserve and improve our timber resources. The Federal Forest Service utilizes a unique mechanical display in illustrating pictorially how forest fires emanate. It is not a cinema, although it appears like a motion picture to the spectator. A metal disk five feet in diameter which is driven by a motor is divided into five units separated by vertical partitions, each section consisting of a model of a heavily forested hillside. Each of the five units presents a different cause of forest fire.

Lightning is a fertile source of timberland conflagrations. How lightning causes fire is shown by means of an invisible electric wire which is suspended above the highest trees of one of the models. As the large disk spins around and this particular unit appears before the spectator, an electric spark is made to jump from the invisible wire apparently located in a big, black cloud to one of the trees whence, apparently, the blaze soon spreads over the forest. This effect is accomplished by means of a red electric lamp underneath the hillside, which is practically transparent.

Ranchers and settlers who are extending their areas of cleared land often start bonfires to destroy the debris. Occasionally on a windy day, the fires get beyond control or on the sly shoot out sparks which ignite neighboring woodland. Stupendous losses of valuable timber annually result from such causes. Another segment of the revolving disk pictures such an occurrence, the clearing, dwellings and live stock of the settler being plainly shown in the foreground of the model. Neglected and abandoned camp fires left by careless hunters, fishermen or campers are also prolific in the annual tribute they exact in the way of despoiled woodland. A third reproduction deals with this subject, the camper's tent being shown in the valley with a smouldering fire nearby which gradually blazes and spreads to the neighboring underbrush.

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*Left:* Campers often neglect completely to extinguish their fires, which subsequently spread over large areas. *Right:* Sparks from locomotives, logging engines and steam tractors are a fruitful source of unintentional conflagrations.

**Where the forest fires come from and why due care should be exercised at all times**

# Solving the Labor Problem—II

## Man-to-man Contact Between Capital and Labor in Place of the Old Impersonal Relationship

By H. C. Osborn, President, American Multigraph Company

IT seems to me that in our more or less popular discussions of Capital and Labor, we have been satisfied to concern ourselves with details at the sacrifice of fundamentals.

The turmoil between Capital and Labor is not so much ignorance as it is misinformation—and I find one side as misinformed as the other. The trouble seems to be the gradual elimination of the man-to-man contact of a generation ago, replacing it with cold, impersonal employment relationships.

By way of contrast, I recall the stories told me by men who worked for my grandfather. He was the founder of one of Cleveland's big rolling mills and one of the first employers of large groups of men. They tell me that he and his men were real friends; that at noon time he and the men would take their lunch boxes out into the mill yard and seated upon a pile of rails, discuss everything from politics to business. He never knew what labor trouble was. He knew his men, they knew him, and both groups knew all about the business that gave them their living.

Then, when I was finishing my education I became an apprentice machinist in a big Cleveland shop. There I got the other viewpoint. The angle of the man who does not understand the business but who feels himself oppressed by a "System" of which an invisible "Big Boss" is the directing force. To me and the men I worked with, the one aim in life was to get as much as possible for the services rendered. We never knew what the business was all about—and no one in the business seemed to care much whether we found out. There was sort of an atmosphere of "Choosing Sides." We working men had our side and "They" had theirs.

It's that sort of thing that has increased and multiplied to the point that we have now reached. Business has allowed its two factors to become so interested in watching one another that there seem to be few people left to interest themselves in business.

Before we talk about improving conditions, we must recognize the fundamental conditions that are at work and set about bringing a real recognition, on the part of both capital and labor, of the fact that alone they count for nothing—combined, they are useful to themselves only so long as they serve the purpose for which the business was created—rendering some sort of a service to a customer.

From our earliest days we have tried to keep that ideal before ourselves and our men. The first multigraphs built were delivered to Cleveland concerns, and so great was the interest of the men building them that many of the fellows (there were about fifteen of them) had private records of where those multigraphs were and how they were functioning.

We have tried to preserve this spirit as we grew. We have tried to show each man that the part he was working on had some definite service to perform for a customer. By means of talks, charts and pamphlets we have endeavored to show our men the correct relationship between capital and labor, and the part they, as individuals, played in the world of business.

One of these talks, "Modern Business Organization," traced the history of business from the barter age to the present-day corporation. It took the men through the various stages of business and traced the relationship of capital to labor, pointing out their absolute dependence upon each other and their united dependence upon a customer. The result of this was a more united understanding of the part that the worker plays in industry, plus a keener interest in the daily task, because of the realization of the importance of the customer.

Another talk, "Cash to Cash," dealt with the company balance sheet. In this talk we took our annual statement and analyzed it, pointing out the various factors that make up our business and their correct relationship to each other. Overhead, dividends, taxes, surplus, and reserve—all those otherwise unintelligible terms were explained and illustrated by charts and demonstration. Overhead, for instance, was demonstrated to the men by having those whose jobs were part of non-productive labor explain what they did and why it was important. We began with the salesman; had him turn his order over to the clerk in his office, who in turn presented it to the order department man, who then passed his orders around to the various production control units, and so on until the manufacturing order was out in the factory and the man at the machine was at work. By this means we demonstrated the need and importance of the so-called "White Collar" man, and the factory man saw Overhead as an assistant rather than a burden.

All this took time. The course took about a year to give, and covered all possible phases of our business and industrial relations. It was given to a group of about two hundred men who stayed after hours to take the course. We called it our "General Shop Efficiency" course, and out of it grew a demand for the present educational work which covers Foremanship, Mathematics, Shop Practice, Blue Print Reading, Corrective English and Public Speaking, Advertising and Salesmanship, and Business Arithmetic.

*THE very magnitude of modern industry has introduced numerous problems which were unknown to the business minds of a generation ago. Problems of securing raw materials, transportation, distribution, publicity, labor—all of these are peculiar to our present industry. But of all these problems none appears to be so persistent and so difficult to solve as that of labor. How to obtain the proper kind of labor, make it take an interest in the work and ideals of the organization, and prevent it from drifting from place to place with all the losses which such practice entails, is the problem before us. In a previous article we had Mr. Verity, President of the American Rolling Mill Company, explain his company's plan for solving the labor question. This time Mr. Osborn, President of the American Multigraph Company, gives his views and experience on this great question.*—THE EDITOR.

**H. C. Osborn, who calls our attention to the fundamental conditions of the labor problem and how they may be met**

Immediately following our course in "Workingmen's Economics" we began discussing employe representation. Here again charts were used. We showed how the Board of Directors tied the stockholders and the management together, at the same time pointing out how some system of employee representation could be made to give that same contact between management and workers. We let it go at that and appointed several informal committees to investigate existing forms of employee representation and report.

The outcome of it all was the adoption, March 1st, 1919, of the system of employe representation under which we are now working. The system is our own product, made to fit our own particular requirements, but in its fundamentals resembling many of the systems now in successful operation.

We have a Congress of 24 members, elected by the workers. There is a Senate of 14 members holding office by virtue of position, each member being head of some division of our business. There is a Cabinet, the executives of the company, and in case of a total disagreement (something which in a year and a half's experience has not occurred) there is an Arbitration Board.

The Congress is further split into committees. There are fifteen of them as follows: Employment and Discharge; Education and Publication; Health, Sanitation and Safety; Suggestions; Elections; Time and Motion Study; Spoiled Work; Machinery and Tools; Production; Recreation and Entertainment; Attendance and Tardiness; Wages and Rates; Miscellaneous Complaints; Pride and Interest; Eight Hours. These committees are constantly at work on the various subjects within their control. The important point of it all is the fact that through the year and a half's experience there has never been a disagreement between the committees and the management. In many cases the management has been willing to go farther than the committee has suggested.

The outstanding accomplishments have centered around about six of the committees. The Wage and Rates Committee installed a system of classifying men according to their ability and accomplishments, then setting rates to apply to each class. Men are measured according to the specifications laid down for each class, and paid accordingly. Every six months this committee checks our rates with prevailing rates in Cleveland and makes whatever recommendations are necessary. It usually surprises our visitors when we tell them that this committee has, in many cases, refused increases, recommended decreases, and suggested the dismissal of men who were not showing progress.

The Spoiled Work Committee concerns itself chiefly with tracing causes of scrap. They fix the responsibility and suggest measures to prevent recurrence. The work of this committee has had a very decided influence in minimizing our scrap bill.

The Time and Motion Study Committee checks and approves all piece work rates. The result has been beneficial in getting rates set and accepted. Our men know that once a rate has been set it will not be changed so long as the method remains the same, and then only after this committee has rechecked the figures.

The work of the Education and Publication Committee has already been described. All educational activities are under control of this group.

The Eight Hour Committee has succeeded in having our working hours reduced from ten to nine, and, six months later to eight—without reducing production. In fact, now that raw materials are coming in better, production is coming along at a better rate than we have ever had at any time in our history. The work of this committee led them into studies of production and machine methods, resulting in many valuable suggestions; but, of even greater importance, it gave the men first-hand information on the problem of keeping the sales force supplied.

The Pride and Interest Committee is working to give our new men the Multigraph spirit—the living spirit of the craftsman who is doing a job he's proud of. Through the work of this committee new men are given some of the tradition of our business. Twice each week at lunch time in the restaurant we have demonstrations of the various models we make. These demonstrations are arranged and managed by the Pride and Interest Committee and new men are given invitations to attend. There is always a good attendance.

Throughout it all we play up the individual. We appeal to the man to make something of himself. We show him that the Multigraph offers him as broad an opportunity as he can want—and more than that,

(*Continued on page 508*)

# "Obstipui, Comae Steterint"

## The Physical Sensations Accompanying the Emotions of Fear and Horror

By M. Tevis

I WAS amazed; my hair stood on end; my voice stuck in my throat"; such is the stereotyped expression of which the first two clauses stand above, and with which Virgil in numerous passages describes the emotions of the pious Æneas when confronted with some appalling spectacle. We recollect, from our own high school days, the gusto with which this familiar line was translated by the member of the class who might be so fortunate as to find it in his assignment; but we do not recall that it ever occurred to any member of the class to inquire why the emotions of terror had this particular anatomical effect upon Æneas or why they continue to produce the same symptoms in mortals of the present day and generation.

The sensations of fear and horror while entirely mental are indeed accompanied by certain marked and very curious instinctive physical reflexes, which Virgil describes with no exaggeration. Thus anyone suddenly confronted by some hideous or appalling spectacle, such as murder, death through accident, the swift and terrible destruction accomplished by a cyclone, etc., exhibits a blanched skin, a falling jaw, widely distended eyes, and similar changes of aspect. Furthermore, he is apt to feel his heart "stop," *i.e.*, check its pulsation for a moment and then begin beating violently. At the same time a cold sweat may burst from the pores of his skin, he may be seized with a violent tremor and he may feel that curious prickling sensation of the scalp commonly described in the term "my hair stood on end." All these familiar signs of a physical disturbance corresponding to a mental disturbance and occasioned by the latter operate in accordance with certain physiological laws and according to a definite mechanism.

Take the rising of the hair, for instance. The skin is covered everywhere except in the palms of the hands and the soles of the feet with hairs. These hairs are inserted in the skin obliquely, the better to fulfil their function as non-conductors of heat, as a protection from blows (upon the skull), conductors of moisture, etc. However, the hairs are not compelled constantly to retain this prone position since each hair is connected with a minute muscle so attached to its shaft as to exert a pull upon it like that of a rope upon a ship's mast. In those animals which are thickly covered with hair or with feathers this capacity for "bristling" is of great importance, since such a disposition of fur or feathers, which is commonly assumed during sleep, makes the covering of the skin warmer, for the reason that particles of hair—a notably bad conductor of heat, become entangled amid the fur or plumage and thus afford the protection against freezing or chilling which is a greater danger at night, because of the lower temperature and the lessened amount of heat generated by the fact of non-activity element.

But as we have said the hair tends to stand erect not merely through the effect of cold but in response to some mental disturbance. Thus a startled cat at once begins to bristle, which has the practical advantage of making the animal appear more alarming and dangerous to its enemies—a bluff which is often effective. Furthermore, the erected hairs present serried ranks of stiff points which are likely to make it more difficult for the enemy to seize the animal; for instance, an attacking dog would find that these stiff points were not only unpleasant to his sensitive muzzle but also that they compelled him to close his eyes, thus interfering with his onslaught. A magnified section of human skin reveals the reason for the instantaneous physical response to the mental emotion in the fact that the muscles controlling the hairs are connected with the brain centers by specially delicate and numerous nerve branches. This mechanism for the erection of the hair is particularly developed among the apes, which are the supposed relatives of man's forerunners. Writing in *Kosmos* (Stuttgart) for January, 1920, Dr. Fritz Kahn observes that this erection of the hair in animals whether induced by cold, by fright, or by anger is really a somewhat complex affair. Between the muscle whose contraction pulls the obliquely-lying hair to a more erect position, and the shaft of the hair itself, lies the gland of the hair follicle whose office it is to secrete the oil required for maintaining the smoothness and flexibility of the hair. When the fibers of the hair muscle contract this oil-filled gland is pressed tightly against the shaft of the hair so as to force out some of the oil. A very slight contraction of the hair muscle, one hardly sufficient to cause a perceptible motion of the hair itself, is enough to cause a flow of oil. Even such a slight stimulus as washing with cold water, friction with a brush or cloth, etc., is all that is necessary to cause this flow of oil. In the case of a very strong stimulus such as severe cold, violent anger, fright, nausea or disgust, the hair muscle contracts convulsively, bringing the hair to a vertical position, expressed by the term "standing on end." Furthermore, the cramped muscle presses the gland of the hair follicle so forcibly against the surface of the skin as to form little granules upon the latter about the size of millet seeds, thus occasioning the well-known phenomenon of "goose flesh." In the skin of birds these oil glands are comparatively large for the purpose of furnishing oil for the plumage, and for this reason little granules are perceptible even when the plumage is lying flat. Since the nerve impulses in response to which this condition of the skin and hair occurs, travel over the body from the brain as a center, it is natural for a person to speak of his "flesh creeping."

But when the nerves of the hair are excited by any stimulus the other organs of the skin are likewise affected. Thus the thousands of sweat glands in the subcutaneous tissue pour forth their drops of perspiration, thus producing the so-called "cold sweat." At the same time there is a contraction of the minute muscles connected with the delicate veins of the skin, forcing the blood out of all these vessels so that it runs back to the interior of the body, leaving the skin both pale and cold. Thus we have a cold sweat in contrast to the warm sweat due to heat, in which case the skin is warm and red from being filled with blood. Lastly, the combined phenomena here described produce the sensation commonly known in the words "a cold shiver ran down my back."

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### Sudden Death Versus Slow Poisoning in the Hudson Vehicular Tunnel

To the Editor of the SCIENTIFIC AMERICAN:

In connection with the proposed construction of the Vehicular Hudson Tunnel for auto traffic, referred to in the SCIENTIFIC AMERICAN of Oct. 9, 1920, and also in the *Literary Digest* of Aug. 14, 1920, Prof. Yandel Henderson, consulting physiologist of the U. S. Bureau of Mines, is quoted to the effect that "If the concentration of CO in the air of the tunnel is kept down to 4:10,000, this concentration will be 'the minimum pollution for a man at rest'"; in other words, if exceptional care is taken that the CO concentration does not exceed 4:10,000, the tunnel will be safe for such traffic to those employed as auto drivers or making use of the tunnel for purposes of passenger traffic.

It has been suggested to me by Dr. Georgine Luden of the Mayo Clinic, Rochester, Minn., who has recently completed some extremely interesting investigations on the clinical after-effects of chronic carbon monoxide poisoning, that in an article on the subject by McGurn to the *Interstate Medical Journal* in 1917, that "a concentration of 1:250,000 inhaled repeatedly for several weeks and months at intervals was found to result in a serious health impairment." Dr. Luden therefore adds that "people using that tunnel, perhaps daily, are therefore going to inhale repeatedly a concentration of CO that is 100 times greater than that which resulted almost fatally in one of McGurn's cases (IV)." She adds further that "Although 4:10,000 CO may not appear to do immediate harm, it is certainly capable of doing harm in the long run and likely to produce a large crop of semi-invalids who may not at first be called neurasthenics but who will end by being ill enough to become invalids for life." McGurn's article is not referred to in Henderson's paper. He may possibly not have been aware of the case reported.

I add to the foregoing a reference to the August number of the *Journal of Pharmacology and Experimental Therapeutics*, in which Henderson and Haggard are very emphatic in their statement that "Within a few hours after profound but non-fatal poisoning with carbon monoxide no trace of the gas is found in the blood. . . . And yet for days, months and even for life structural degenerations and functional chances, usually either nervous or cardiac, may continue." The serious effects of continuous exposure to carbon monoxide have been experimentally ascertained by Dr. Luden, who is of the opinion that there is unquestionably a sensitization to the toxic effects of CO; and that therefore repeated exposure on the part of those who may use the tunnel frequently, assuming the air contamination to be to the extent indicated, will have to be reckoned with.

In a recent dissertation on the Etiological Factors of Carcinoma, submitted to the faculty of the University of Minnesota, Dr. Luden calls attention to the extreme toxicity and ubiquity of carbon monoxide in modern civilized life, the health aspects of which do not seem to have been fully recognized. She concludes that "Absence of noticeable odor, however, does not imply absence of danger. Carbon monoxide is an odorless as well as a colorless gas; its presence would never be detected by our olfactory organ were it not for the addition of the other compounds with which it is usually associated. But even the latter may fail to warn us by their odor. For McGurn was able to show that illuminating gas produced severe clinical symptoms in a dilution of 1:250,000, while Albaugh has recently emphasized the danger of concentrations of 1:2,000. It will be readily conceded that in the first named dilution the presence of the toxic gas was more than likely to escape notice. I might add that since there is a distinct advantage in visualizing the actual value of concentrations by the use of some familiar comparison, a concentration of 1:250,000 may be represented by a small glass of claret (10 cc.) diluted in 625 gallons of water, or in the second instance, mentioned by Albaugh, in five gallons of water. These figures show that the toxicity of carbon monoxide is equaled by its imperceptibility."

I bring the foregoing to your attention as an interesting contribution toward a health problem of present importance. With the technical aspects of this matter I, of course, have only a very slight acquaintance.

Newark, N. J. FREDERICK L. HOFFMAN.

### Prickly Pear Not a Pear at All

To the Editor of the SCIENTIFIC AMERICAN:

My attention has been attracted to the article on "Taking the Pricks Out of Prickly Pear" that appeared in your issue of Sept. 25, 1920, p. 305.

I don't know how accurate you desire to be in articles of such a nature, but I thought it might be wise to call your attention to several misstatements that appear in the article.

Passing the statement that this is a new use (Mr. Burbank commenced to exploit spineless cacti nearly 20 years ago), I'd like to suggest that the so-called "prickly pear" is not a pear at all, that it does not "belong to the big fruit family which (whose) name it bears," and that the part of the plant fed to cattle is not the fruit, but the thickened joints of the stems. Nor is it a "choice ration." As the author states further on in his article, it is an "emergency" feed, ordinarily used only when other more valuable feed is lacking.

The plants referred to (there are a number of species eaten by stock) belong to the cactus family in the genus *Opuntia*. Certain species of this genus have flattened, fleshy stem joints that are circular to ellipsoid in outline and from a few inches to a foot in length. These species go by the common name of "prickly pears" and this name is also applied to the globular to pear-shaped fruits, some varieties of which are to be found at the better class fruit stands in the larger cities of this country.

These plants are cultivated extensively in Mexico where the joints and fruits are used in a number of ways. They call the plant *no-päl'* and the fruit *tu' nä.*

Washington, D. C. E. O. WOOTON.

# Fuel or Fertilizer?

## America's Little-Known Peat Bogs and the Uses to Which They Are Being Put

By Harry A. Mount

THE word "peat" conjures to the average mind the picture of an Irish moor, with a few old men and women at the back-breaking task of spading up cubes of turf and piling them in the sun to dry for fuel. A view of one of the American peat bogs which is being worked would be a surprising sight.

**Hauling the peat from the bog to the fertilizer factory by means of a diminutive locomotive and dummy cars**

One glimpses, not a great swamp waste, but an area as flat as a table and nearly as smooth. Part of it is green with a magnificent crop of celery or onions; over another part tractors drag plows and harrows, and great machines strange to the eye ply back and forth. At one corner of the bog stands a good-sized plant where the peat is turned into products of commercial value; and near it are mammoth storage piles of the black loam.

Because we in America have had heretofore an abundance of virgin land and plenty of coal we have generally overlooked the value of our peat bogs. Indeed many will no doubt be surprised to hear we have any such thing in this country. Our Bureau of Mines estimates that there are in the United States about 12,000 square miles of workable peat bogs, besides a great number of beds advantageously adapted to agricultural purposes.

Aside from its value as fuel and its use in agriculture, peat has a score or more of uses, and its field is being constantly widened. A long list of chemicals are extracted from it. These include ammonia, methyl alcohol, acetone, acetic acid, pyridines, mono-phenols, a gasoline-like spirit, some neutral oils, paraffin wax, tar, and dyes.

The medicinal qualities of peat baths have made them popular in some sections of the world. During the war hundreds of tons of peat moss were used as an absorbent in dressing wounds. A process has been patented in England for making paper from the vegetable fiber found in peat bogs. By mixing molasses with properly prepared peat a food for cattle is made which is used widely in England and Germany. There are other minor uses.

A few plants are operating in this country and Canada for the production of fuel from peat and for the by-products. As a fuel, peat has about sixty per cent the heating value of coal, ton for ton. But it can be produced very cheaply, and since European practise has already shown it can be used successfully in the industries and even in firing locomotive boilers, there is little doubt that it is a coming fuel. More will be said of this phase of the subject in another article.

By far the largest use for peat in this country thus far is in agriculture and in the production of fertilizers. The industry is a new one. In 1914 the total value of the peat consumed in this country was $367,000, of which about two-thirds was used for fertilizers. In 1918 the peat used was valued at $750,000 and although official figures are not available for 1919, the value is believed to run well over a million dollars. Of this perhaps even a larger percentage than in 1914 was used for fertilizers.

To understand the production of fertilizer from peat, it is necessary to know something of the nature of these natural deposits.

Peat deposits are built up by water plants on the beds of lakes—plants which die down annually through many years, until the deposits reach the surface and the lake is turned into a swamp. It is in this state that the peat is usually found.

The plants, as they die, are preserved by the water and a process of very slow decay takes place. If the bog is a young one, the muck which composes it will be of a fibrous nature, but if the bog is a very ancient one the fibers may have disappeared entirely and the muck will be a fine-grained loam when dried.

In its natural state peat may consist largely of water; and even after the bed has been drained the peat has a moisture content of about 90 per cent. The peat retains the water just as a sponge does and before the product is of commercial value the water must be reduced either by sun drying, pressing, or with evaporating machinery.

**Putting peat on a commercial basis. The driers in the peat plant**

The value of peat as a fertilizer lies principally in the fact that it is very rich in the essential plant food, nitrogen, but lime, potash and phosphoric acid added to produce a "balanced ration." But of scarcely less importance is the fact that it provides an ideal habitat for the billions of tiny bacteria which infest all soil and whose activities convert these food-chemicals into a form which the plant can assimilate. In fact, the presence of the nitrogen in the peat can be attributed to these little animals, so tiny that thousands of them can be collected on the head of a pin.

Under the microscope these bacteria are seen to be animals of the lowest form, which reproduce themselves by splitting into two parts. Under favorable conditions two bacteria grow from every one every forty minutes. Those who wish to carry out the mathematical progression will find that a single bacteria will have increased to about 165,000,000,000,000 in twenty-four hours. Of course many, many billions of them die in that time, or they would soon overrun the planet and crowd off every other form of life.

Have you ever pulled up a clover root and noticed the little balls, like tiny potatoes, clinging to it? Within these balls are millions of the particular bacteria which thrive upon the roots of clover. And each of these little balls represents the additions of so much nitrogen to the soil, for these bacteria have the power of drawing nitrogen from the air. It was known, long ago, that corn or potatoes grew better in a field which had had clover in it the year before and it has become a common practise for farmers to plant clover and plow it under as a fertilizer.

Another variety of bacterium clings in a similar way to the roots of beans, and another to peas. The plants of this family all have the peculiarity of attracting beneficial bacteria under favorable soil conditions. They are called legumes, and the little balls which gather on their roots are called nodules.

It was once the practise, when a field of clover failed to produce the nodules, to carry soil from another field of clover; and in this way the new field was inoculated with the bacteria. The farmer did not know why he did it, but with the forward march of science these bacteria were isolated, their habits studied, and they were artificially bred in gelatins. These gelatins could be purchased, mixed with water and the bacteria sprayed over the land, or mixed with the seeds which are to be grown there. But it was necessary to buy a different gelatin for each separate crop. A search for a strain of bacillus that would be universally useful proved fruitless. And then the happy discovery was made that peat is an ideal home for all varieties of these bacilli and the problem was attacked from a different angle. All of the different breeds were introduced into the peat; now this inoculant may be used for any of the

**A celery crop in the New Jersey peat bogs where formerly there grew nothing but swamp grass**

(*Continued on page 509*)

## A Tractor That Turns in the Space It Stands On

By Ralph Howard

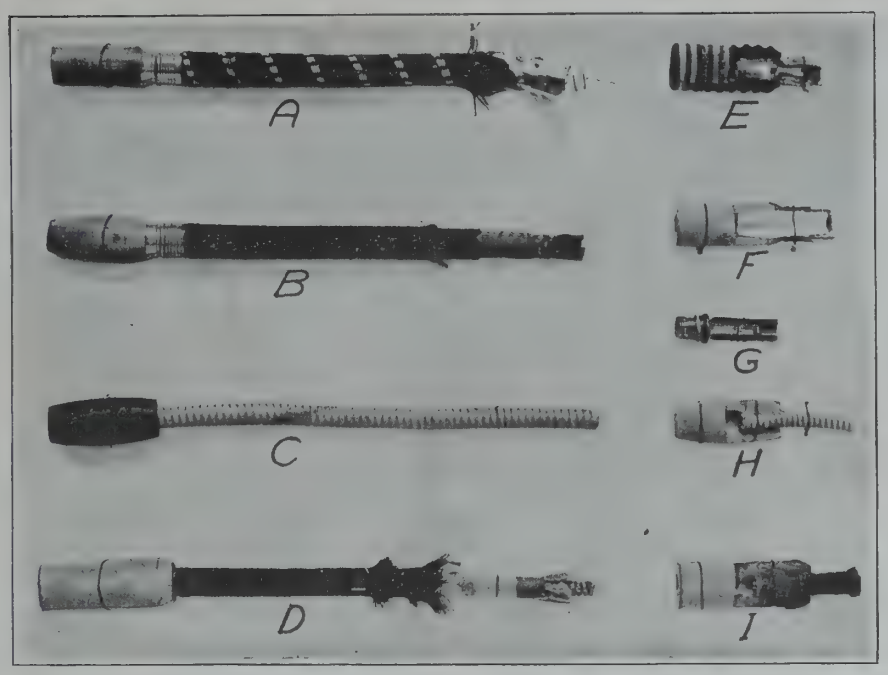
WONDERFUL as has been the progress in tractor development in the past, tractor engineers and manufacturers see a further step forward in a tractor constructed on new basic principles now being exhibited in California. Primarily, this tractor is a round-wheel type, having four wheels of equal size with the power distributed equally to all four. The wheels are arranged in pairs on the tractor and held against lateral turning movement relative to the tractor, the wheels on either side of the tractor being connected in driving relation with each other, but only one pair being connected with the power unit of the tractor. The wheels on either side of the tractor are turnably mounted on their axles independently of those on the other side and the driving connection has been arranged to be susceptible of being interrupted relative to either or both pairs of the wheels. On either side the wheels are as readily locked against rotation as they are released from their driving connection. By this means the tractor may be steered in arcs of various radii, or it may be steered at right angles to itself when short turns are made.

With the driving means so controllable as to permit the machine to be turned in arcs, the radii of which may be less than the length of the machine and from that up to any length desired by the operator, according to conditions under which the machine may be working, it became necessary to mount on the periphery of the wheels leaders of such shape and design as to permit the machine to turn without causing the leaders or guides to plow the ground. None of the wheels can be used as steering wheel independently of the tractor as a whole, but when a turning movement is to be imparted to the tractor the entire machine is turned in a rigid movement with the power so applied as not to cause any undue lateral strain on any part of the tractor. The whole operation is carried out with a pivot-like movement, produced primarily by the peculiar construction and arrangement of the leaders or guides on the wheels.

These are so constructed and mounted on the wheels that in a turning movement the leaders on the inside wheels, or non-rotating wheels, act as guides to direct the pivotal movement, but a directly opposite effect is had on the outside, or rotating wheels, to which the power is wholly or in part applied. The diameter of the circle of movement of the inside wheels may be increased or decreased by clutch control, through a relatively small movement of the steering wheel, but the general operation and function of the parts will still be present in the relation described. The entire turning movement is carried out with minimum lateral strain on the wheels or machine as a whole. A slight movement with a minimum of power is obtained by both ends of the guides being beveled so that there is a lifting effect tending to raise the wheels out of the ground instead of causing the wheels to plow the ground, as they might do were they not so beveled. The angle at which the guide may be set with respect to the axis of the wheel to obtain the maximum turning ability has been determined by practical trials. The turning movement can only be successfully accomplished when the guides are so set with respect to the axis of the wheel. The same successful turning can be done in forward or backward movement. Maximum gripping effect is necessarily of prime importance, and is secured without tearing the ground by giving depth to the leaders.

Equally important in facilitating the turning movement is the application of the power to the drive wheels. Through a specially designed transmission in which the maximum amount of power is delivered, due to the simplicity of construction, the driving power is readily applied or removed from the two wheels on either side. By the application of this power to the front wheels an equalization of power is obtained on all four wheels, which overcomes any tendency for the front end to rear up no matter how great a load the tractor may be pulling, nor how suddenly the power may be applied to the wheels. The power is evenly distributed on all of the wheels.

The operation of the tractor is simple. The operator is comfortably seated with the clutch pedal and gear shift lever at hand, and he has easy control of the movement of the tractor by a neat steering wheel. This wheel, by slight movement, operates a cam control, through which the power is applied or released from either side of the tractor. Further movement of this wheel locks the wheels on either side of the tractor. By this steering mechanism two wheels on one side of the tractor are simultaneously released and a brake applied to them with effective results.




**Four types of flexible gas tubing and five end connections which were tested by the Bureau of Standards, with the results set forth in the text**

## Gas-Tubing Tests

By S. R. Winters

THE door is unfastened, the occupants of the room are found cold in death, the reason is unmistakable—briefly summarized, another tragedy is traceable to escaping gas. Not improbable, the leakage of the death-dealing fumes had its source in faulty gas tubings. Recognizing the hazards to life and property incident to unsatisfactory gas conveyances and connections, the Gas Engineering Section of the United States Bureau of Standards has conducted a series of experiments with relation to nine types of gas tubings, the results indicating their relative safety.

The manufacturer who wrote the Bureau of Standards, "The demand is very largely for the cheapest tubing that can be turned out that will stay tight long enough for it to be sold," probably reflects the levity with which flexible tubing and tubing ends are installed. The design which is constructed of paper, covered with glue, on a wire spiral, being covered with a cotton braiding of inviting appearance is pronounced dangerous by the Gas Engineering Section of the Government. The photograph herewith displays the nine types, the text describing each being supplied by the Bureau of Standards as follows:

(A) A dangerous type of tubing constructed of paper, covered with glue, on a wire spiral, the whole covered with a cotton braiding giving it a good outside appearance. The glue soon hardens and cracks upon bending the tubing.

(B) This tubing, constructed like a garden hose of cotton fabric impregnated with rubber, is flexible, gas-tight, but dangerous if subjected to high temperatures.

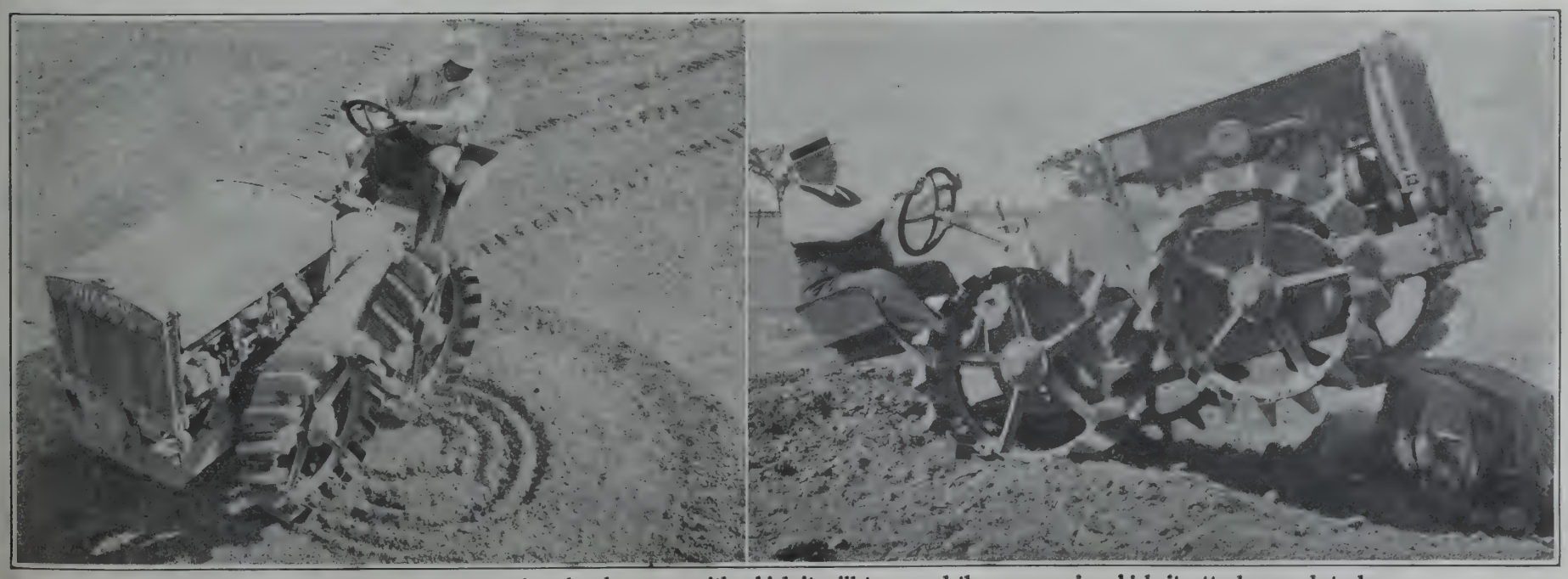
(C) The common type of metallic tubing, which depends for its tightness upon a rubber thread packing within the metal spiral. This rubber thread deteriorates with age, especially if overheated, causing small leaks in the tubing which might allow dangerous quantities of gas to escape, though not presenting much fire hazard.

(D) A very good grade of flexible tubing constructed of a gas-tight metal core covered with successive layers of paper, fabric, glue-glycerine compound, paper, and two braided coverings. It has the advantages of a metallic tubing of type (C) with some additional durability due to the superimposed layers.

(E) A very satisfactory type of tubing end piece if constructed of good quality materials. It consists of a threaded metal tail-piece, one end of which is screwed into the tubing and the other end is screwed into the rubber end piece, making the connection about as strong as the tubing itself.

(F) A common, but not always satisfactory, connection, consisting of a wood tail-piece glued into the tubing and rubber end. The gas passage is unduly restricted. The strength and durability depend upon the quality of glue used and the care with which the end is attached.

(*Continued on page 510*)



**Two views of the new tractor, showing the sharpness with which it will turn, and the manner in which it attacks an obstacle**

# The Traffic Problem in New York City

## Subway Extensions to Take Care of an Ultimate Annual Travel of Nine Billion Passengers

THE construction of adequate rapid transit facilities for the city of New York is rendered particularly difficult by certain special conditions which control the problem.

Foremost among these are: first, the unfavorable topographical condition that the heart of the city, to and from which traffic flows in the rush hours, is situated on the lower end of an island which is separated from the surrounding territory on the south by the broad waters of New York Bay, and on either flank by the wide and deep North and East Rivers; second, the vast population now amounting to nearly 6 million which is to be served; and third, the fact that the growth of travel takes place at a steadily increasing ratio.

Not only is the business center of Greater New York so far as regards transportation, pocketed at the southern end of Manhattan Island, but the great development in the number and height of tall office buildings has brought a corresponding increase in the density of the working population during business hours, with a corresponding added congestion of the transit lines.

### Commencement of Rapid Transit

Rapid transit in New York City commenced about fifty-two years ago, or in 1868, and consisted in the first place of surface horse-drawn cars. These were supplemented about ten years later by the elevated railroads, and in 1904 the first of the subways was opened. It was not until the beginning of the present century that the city fathers began to get some glimmering of the stupendous problem which confronted them in the attempt to keep pace with the growth of population and business concentration in lower Manhattan, and the growing tendency for the business population to make their homes in the suburbs. At that time the streets were occupied by surface and elevated tracks and because of their noise and unsightliness it was realized that the public would never agree to the construction of additional elevated lines on Manhattan. Consequently, the only available field for enlargement was underground. Thus the idea of the construction of subways had its birth and an active campaign was carried on to enlist public sympathy and support.

The first subway system was opened in 1904, and it not only verified all the predictions of its sponsors, but was so successful that it carried a total number of passengers far in excess of the most sanguine estimates. Forewarned by the growing popularity of the subway, the rapid transit commissioners immediately formulated plans for its extension; but nothing material was accomplished until 1913, or nine years after the first subway was put in operation, and traffic had caught up.

### The Dual Subway System

Then the so-called dual subway system was consummated and contracts were made between the city and the existing Interborough Rapid Transit Company and the New York Municipal Railway Corporation. The dual system, which practically doubled the trackage and trebled the capacity of the then existing rapid transit facilities, is very nearly completed, but its construction was greatly delayed and its cost practically doubled during the war. The whole system will carry about 2,400,000,000 passengers during the year 1920, and when the last extensions have been completed and everything is in full swing, it is estimated that it will accommodate about 3 billion passengers. Already, in spite of the increased facilities, the subways are heavily congested, and every citizen who uses them will agree that the city should push the system to completion with all possible dispatch, and in the meanwhile lay its plans for further extensions to meet the demands of the future.

An exhaustive study of this subject is found in a report by Daniel L. Turner, Chief Engineer, which has recently been submitted to John H. Delaney, the Rapid Transit Commissioner for this city. Mr. Turner's report is divided into two sections, one dealing with the requirements of the next twenty-five years, and the other with the probable needed extensions of the next seventy-five years, or, say, up to the close of the present century. The larger scheme is presented by the map and drawings found on the first page of this issue, but it should be carefully noted that it is not the intention, nor is it recommended, that the whole of this scheme should be put into execution at once, but only such parts of it as will be sufficient to meet the needs of the city up to the year 1945.

The estimates for 1945 and 1995 are based upon a study of the rate of growth of traffic during the present century, and particularly during the decade 1910 to 1920, and also upon the rate of growth of the population of greater New York. The figures represent the total travel of all systems of transportation, street-surface, elevated and subway. They show that in 1910 the total number of passengers on all systems was 1,527,000,000. This has increased to 2,400,000,000 in the year 1920, and if the growth in population and travel continues at the same rate, the city will have to provide for an annual travel in 1945 of 5 billion passengers, and in 1995 of over 9 billions.

### Early Construction to Meet the Necessities of the Next 25 Years

The extensions which are recommended to be commenced immediately, and the work to be done in finishing up of the present dual system are as follows: Extension of Corona Branch of the Steinway tunnel line to Main Street, Flushing; also, on Manhattan, the extension of the Steinway tunnel line from Seventh Avenue and 41st Street west to connect with the proposed Amsterdam Avenue—Eighth Avenue Trunk line. A two-track extension of the present Broadway-Fourth Avenue line from 59th Street up Central Park West to the Harlem River; and extension of the Broadway-Fourth Avenue line from City Hall Park by way of Ann Street to East River to a connection with the Fulton Street elevated line near Ashland Place, Brooklyn. An extension of the Fourth Avenue subway, Brooklyn, by way of a two-track tunnel under the Narrows to the Borough of Richmond. An extension of the Nostrand Avenue subway to Coney Island. An extension of the Astoria Branch of the Steinway tunnel south through Queens and Brooklyn to a connection with the Brighton Beach line, thereby providing a Brooklyn crosstown line. A two-track extension of the Seventh Avenue-Broadway line from a point at Greenwich and Liberty Streets by Maiden Lane and the East River to Brooklyn, and thence by Hicks Street to a connection with the Culver line.

### New Trunk Lines

In the Borough of Manhattan two additional trunk lines are to be built, one extending below Eighth Avenue and Amsterdam Avenue from 23d Street to 155th Street. This will be the most important trunk line of the whole subway system, for it will be a double-decked structure, four tracks upon each level. The immediate construction will include only four tracks of these eight.

There will be a collecting and distributing branch from 155th Street to upper Manhattan and the Bronx, by way of Fort Washington Avenue to Spuyten Duyvil, and thence by Netherland Avenue through the Riverdale section. From its southern extremity a branch will extend through 23d Street to the East River, and another branch will extend south down Hudson and Washington Streets to the Battery or South Ferry.

The immediate 25-year program calls also for a new East Side Manhattan trunk line, consisting of four tracks of what will ultimately be a six-track trunk line under Madison Avenue, reaching from 23d Street to the Harlem River and having a two-track collecting and distributing branch from 23d Street down Fifth Avenue and lower Manhattan to some point near Park Place.

### Crosstown Moving Platform

The crosstown traffic and cross-over passengers from the East and West Side northerly to the West and East Side southerly portions of the various trunk lines are to be accommodated by moving platforms which, because of their great capacity, are well adapted to take care of this class of traffic where capacity is of more importance than speed. For the 25-year program there will be three moving platforms located respectively at 14th Street, 42nd Street, 57th Street, to be followed after the 25-year program is completed by others through 23d and 34th Streets.

Chief Engineer Turner's report states that it is impracticable to estimate the construction cost of this 25-year program because of the long period over which the work would extend. At pre-war prices it is estimated that the cost would be in the neighborhood of 175 million dollars, but at present prices the cost would amount to 350 million dollars. In all probability the cost will be intermediate between these two figures. In conclusion, we cannot do better than quote the final paragraph of this report, for upon the full recognition of the principles therein laid down, depends undoubtedly the success of our future transit operations.

"The new transit lines should precede the population. The new transit plan should be the basis of the city plan. Upon these two cardinal principles the future of the city depends. The foresight exercised in developing its transit facilities and in conforming its future expansion thereto will largely determine the prosperity of New York City in the years to come."

*Do You Know That—*

The transportation system of New York City—street cars, subways and elevated lines—carried 1,527,000,000 passengers in 1910.

These lines carried 2,400,000,000 passengers in 1920.

It is estimated that in 1995 they will be called upon to carry 9,000,000,000 passengers.

To accommodate the existing traffic there are, in addition to the elevated and surface lines which hardly admit of extension, 616 miles of single-track subway and 34 tunnels beneath the waters about the city.

To accommodate the traffic of 75 years hence it will be necessary to build 830 miles of new single-track subway and 42 new sub-aqueous tunnels.

At present prices, so much of this program as is likely to be called for by the traffic needs of the next twenty-five years will cost some $350,000,000.

Such is New York's rapid transit problem.

## Radio-active Pottery

A NEW method of applying the well-known healing properties of radium is reported in a German magazine. Many natural waters have been found to be radio-active and their presence in the springs of certain resorts has undoubtedly occasioned or added to the fame of these, but it has been discovered that any kind of water can be made radio-active by the action of radium, consequently some one has had the ingenious idea of simplifying this process by making jugs and other vessels of radio-active clay. It has been found that certain clays employed in the manufacture of pottery readily lend themselves to a mixture with radio-active substances without injury to their ceramic qualities, especially the property of being readily molded and fired. The most important radio-active substances employed are the uranium pitchblend which is found in considerable quantities in the Joachimstal in Bohemia, and the mineral called Fergussonite, as also the residues remaining from the working of uranium ores.

These substances are mixed with the clay which is then molded into the desired shape and fired. Certain precautions must be observed, however, during the firing—in especial the clay must be prevented from becoming too much vitrified and contracting too greatly. It must, on the contrary, preserve as large as possible an external surface and thus remain porous in the interior. This is accomplished by a suitable modification of the firing process. The vessels thus prepared are first sprayed with fused aluminum and then receive a thicker layer of metal (copper or brass). When water is poured into a jug thus prepared it becomes highly radio-active in the course of a few days. Instead of jugs clay tubes can be manufactured in the same manner and simply slipped into ordinary drinking vessels. The radio-active water obtained in this manner is used not only as a curative agent but it is suggested that it be employed for the watering of plants, since it has been discovered that radium is favorable to the growth of vegetation.

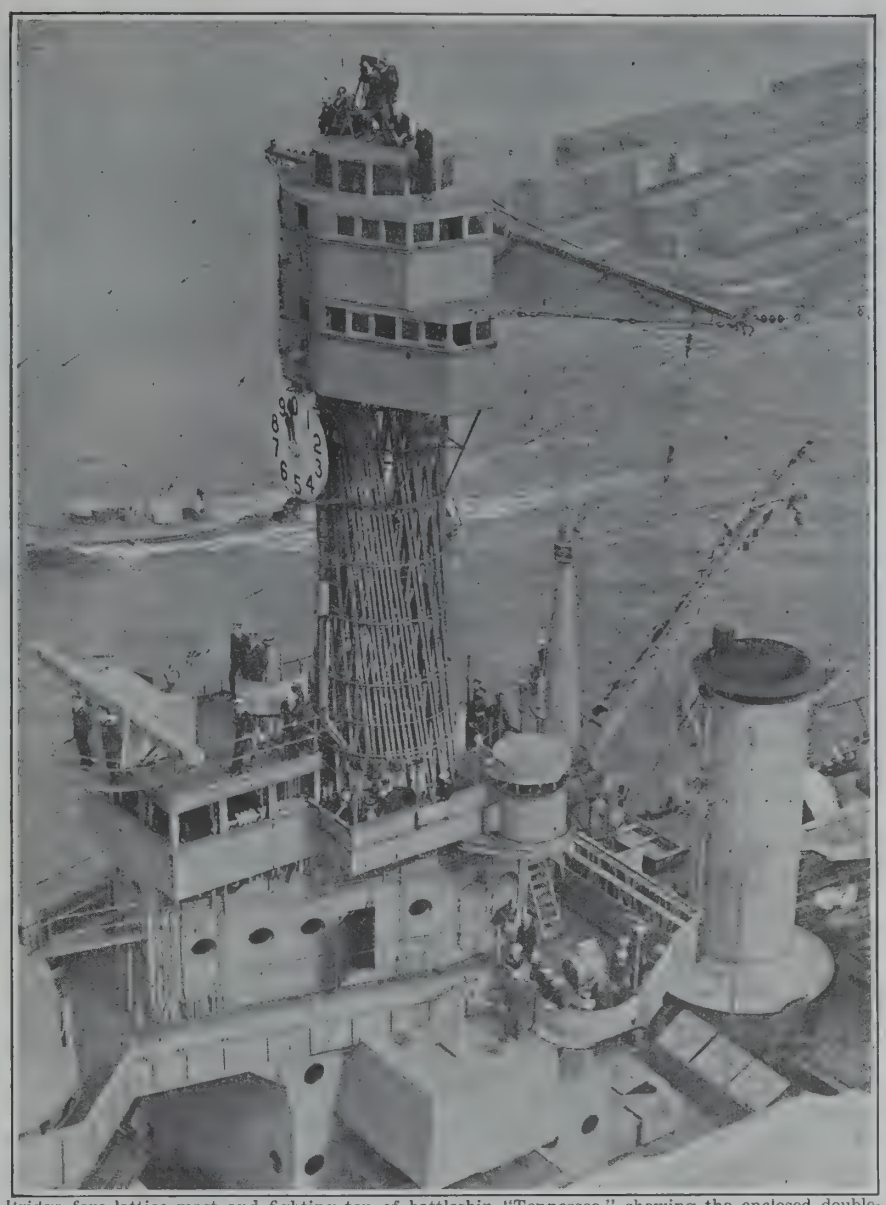
## "Tennessee"—Our Latest Battleship

### A Ship Which Embodies Many of the Tactical Lessons of the War

THE battleship "Tennessee" (sister to the "California") which was laid down at the New York Navy Yard in May, 1917, recently left for a "shaking down" cruise to Guantanamo, Cuba, at the conclusion of which she will be given her speed trials for acceptance by the Navy Department. Her principal dimensions are: length between perpendiculars, 600 feet; beam, 97 feet, 3½ inches; mean draft, 30 feet 3 inches; normal displacement, 32,300 tons; and full load displacement with 31 feet of draft, 33,190 tons. Her motive power consists of a Westinghouse turbo-electric drive, with two main generators and four propelling motors. In the boiler room are Babcock and Wilcox oil-fired boilers, and her estimated shaft horse-power is 38,500. The main battery consists of twelve 14-inch, 50-caliber guns which are emplaced in four 3-gun turrets, all of which are mounted on the center line of the ship and are available on either broadside. The secondary battery, which is mounted in casemates on the spar deck, and upon the boat deck, consists of fourteen 5-inch, 51-caliber guns. For anti-aircraft defense there are four 3-inch guns. The "Tennessee" mounts two torpedo tubes, one on each beam, for firing the 21-inch torpedo. The complement of the ship is made up of 130 officers of all ranks, and 1,281 men. An unusually large part of the displacement of the ship is given over to armor protection, the belt having a maximum thickness of 14 inches. The funnel bases are heavily armored. The port plates of the turrets are 18 inches in thickness.

A great deal of thought has been given to protecting the ship by limiting the inflow of water below water line, caused by shell fire or torpedo. Between the outer shell of the ship and the engine and boiler rooms, magazines, and other vital elements, there are several longitudinal walls of steel which are intersected by numerous transverse bulkheads. This provides the ship with a wide cellular belt, whose effect will be greatly to limit the flooding which results from the successful blow of a torpedo. Also, the vitals of the ship are protected from shell fire by several stout steel decks which, it is hoped, will serve as shell bursters and by breaking up the shells prevent any penetration below the protective deck.

During the service of our Sixth Battle Squadron with the Grand Fleet in the North Sea, there was a very free exchange of ideas between our own and the British navies, as there was also between the various departments of the two navies, and when our squadron returned to this port they presented to American eyes several new features which they had brought with them from the area of naval operations. Several of these features have been embodied in the "Tennessee," with many improvements worked out in our own department. Among our own developments is the large enclosed structure at the mastheads which takes the place of the old, open, fire-control platforms as they were known in our navy in pre-war days. These enclosed "tops" were necessitated by the improvements in director firing, in which the aiming of the guns is controlled by officers stationed in lofty positions and preferably at the masthead.



Bridge fore lattice mast and fighting top of battleship "Tennessee," showing the enclosed double-deck structure in which the directorscope and the instruments for finding and keeping the range of the enemy and his bearing are housed, together with the fire-control personnel. Note the close massing of the latticed tubing, to ensure rigidity.

**The new-type fighting top of the "Tennessee"**

In no direction has there been such progress as in this matter of gunnery. Both in the British and in our own navies some really wonderful instruments have been devised for finding the range and bearing of the enemy and keeping on the range in spite of the deviation of one's own or the enemy ship. Among these may be mentioned range-finding instruments, target bearing instruments, and those for range keeping; and, of course, there is the form of telescope known as the directorscope. It has become necessary to give ample protection both to these instruments and the officers and men who operate them. This accounts for the remarkable double-deck structure which is such a conspicuous feature at the head of each of the lattice masts of the "Tennessee." It will be noticed, by the way, that these masts are very much more massive in construction than those of our earlier ships. This change is due to the necessity of damping out as quickly as possible the intense vibrations which are set up in the structure of a battleship and particularly at the mastheads, when a salvo from its big guns is fired. Also, it is desirable to reduce to a minimum a certain amount of springing of the masts, due to inertia when the ship is rolling or plunging heavily. The British use a combination of three very stout steel masts arranged in tripod form. Doubtless, this gives a stiffer platform; but in the opinion of our Navy Department, the tripod mast could be more easily shot away or seriously disabled than our lattice masts, which are made up of a very large number of spirally grouped steel tubes.

Another development of the war is the use of director firing, not merely for the main battery, but also for the 5-inch torpedo battery. These, of course, have to be separate installations and hence we have the two separate director rooms, one above the other.

Another conspicuous feature which will be new to American eyes is the large clock face at the front of the foremast. This is a British device which gave satisfaction. It is used when a fleet is steaming in column to indicate to the ship ahead and the ship behind (there is another clock on the rear of the main mast) the speed at which the ship is traveling—a necessary precaution in keeping proper distance and station. At the foot of the foremast and some distance ahead of it is a large covered range-finder, and below this is the navigating bridge. Below the bridge where we see the circular port holes is the chart house which is surrounded by the signal bridge. A group of signal men will be noticed in the right-hand corner of this bridge, with the racks for the signal flags behind them, and the signal halyards leading up to the signal yard at the top of the mast. Forward on this bridge will be noticed the top of the conning tower.

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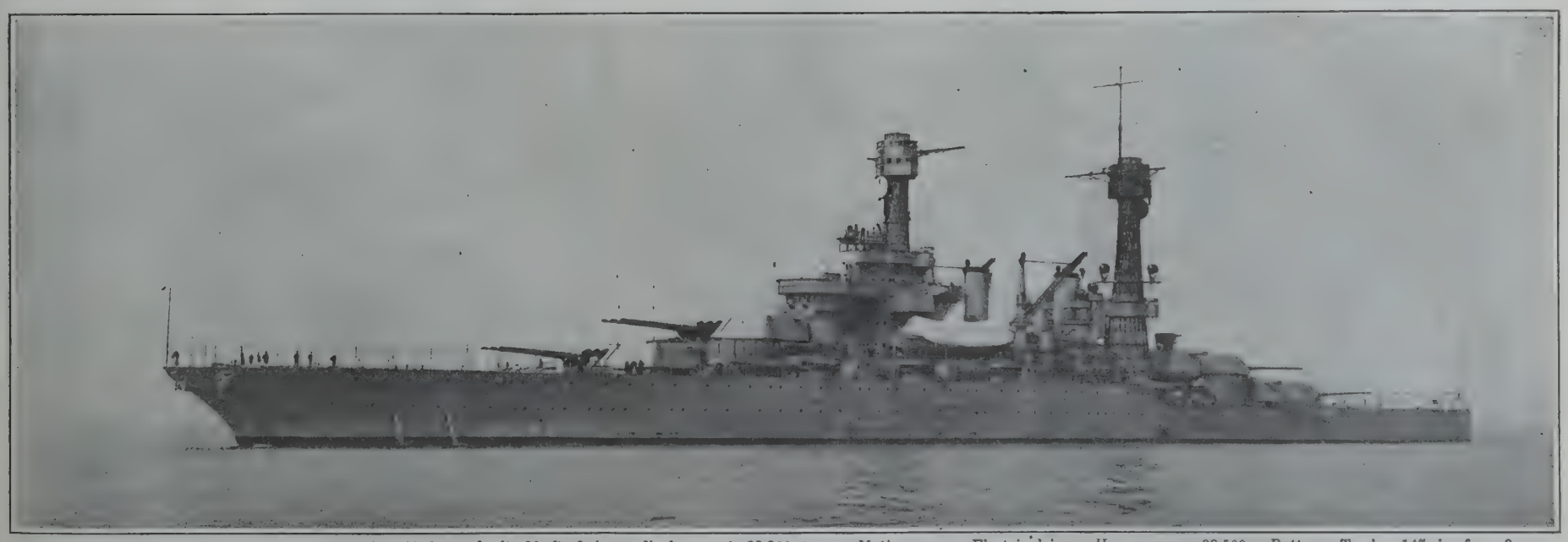
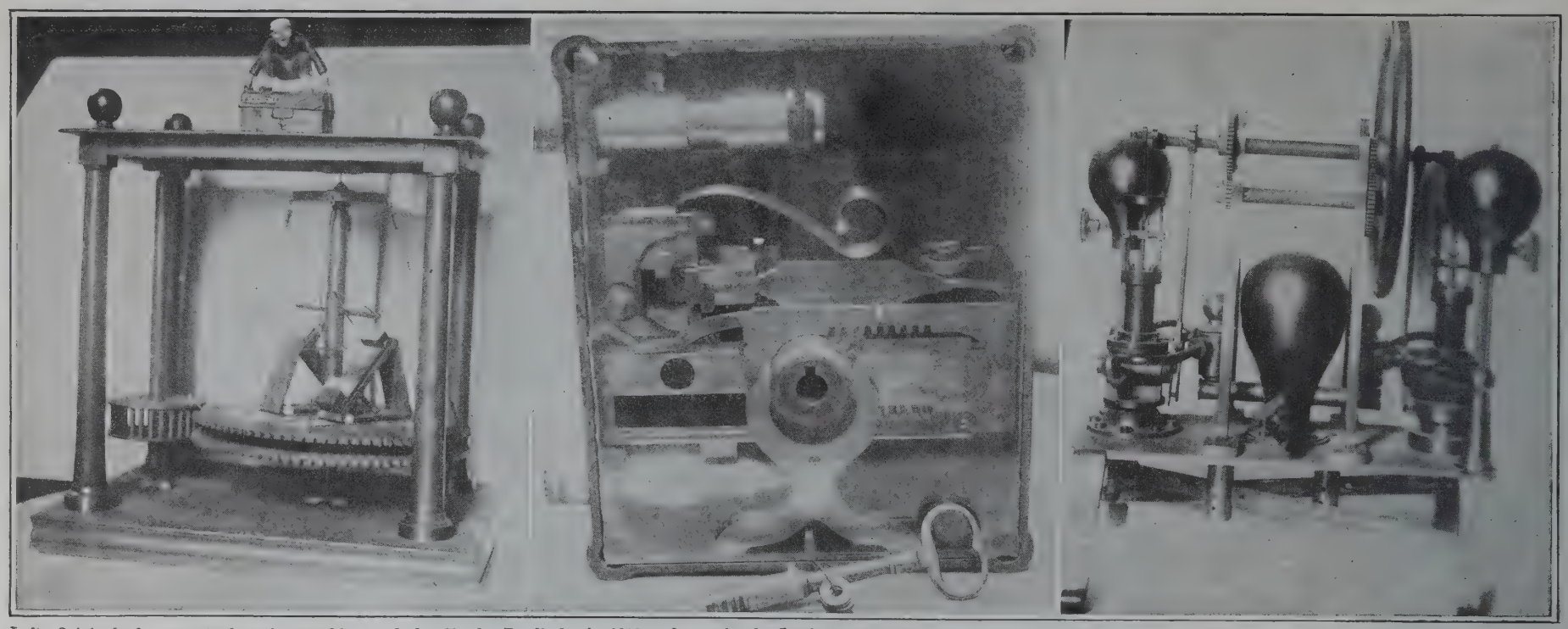


*Length*, between perpendiculars, 600 ft.; 97 ft. 3½ ins.; *draft*, 30 ft. 3 ins.; *displacement*, 32,300 tons. *Motive-power*, Electric-drive. *Horse-power*, 38,500. *Battery*, Twelve 14" in four 3-gun turrets, fourteen 5". *Armor*, belt, 14"; turrets, 18". *Complement*, 1,411 officers and men.

**Our latest battleship "Tennessee," leaving New York for a shaking-down trip, preparatory to her trials**



*Left:* Original of a perpetual motion machine made by Charles Readhefer in 1810 and now in the Institute museum. *Center:* Original model of the Yale lock, on exhibition at the Franklin Institute. *Right:* Original of the famous Keeley perpetual motion motor, against which the SCIENTIFIC AMERICAN waged a winning fight

**Three interesting items from the museum of the Franklin Institute, one of which had the Institute's endorsement**

# First Aid for Inventors

## The Franklin Institute and the Committee Through Which It Assists Meritorious Patents

### By William A. McGarry

UNKNOWN inventors storming the citadel of fame with brains and mechanical or scientific ingenuity too often discover that these resources are of relatively little value in finding a market for their achievements. It has been said that the hardest part of the inventor's work begins after he has obtained his patent, when he starts the weary grind from office to office seeking financial backing to commercialize the product.

Yet for nearly a century one of the world's most famous scientific institutions has maintained a corps of experts "to examine and make report upon all new and useful machines, inventions and discoveries submitted to them." The individual services of the members of this corps command anywhere from ten to a hundred thousand dollars a year, and the wealthiest corporation in the country would go bankrupt if it tried to hire all of them. But inventors may have their advice for the price of postage stamps.

These men are the members of what is now known as the Committee on Science and the Arts of the Franklin Institute, founded in 1824 at Philadelphia as a memorial to Benjamin Franklin and for the promotion of the mechanic arts. Free scientific examination of appliances and processes was one of the first functions of the institute. In the beginning the work was done by a "Board of Examiners." Later it was turned over to a "Committee on Inventions," and in 1834 the present committee was established. Until 1886 membership on the committee was open to any member of the institute, but in that year it was decided to limit the body to forty-five members "who shall pledge themselves by their acceptance of membership to perform such duties as may devolve upon them, and to sustain by their labors the scientific character of the institute." Still later the number was increased to sixty members.

The work of this organization in behalf of inventors is not intended to provide easy access to unlimited capital, but that, in effect, is what it does when an invention is of sufficient importance to warrant even a favorable mention. When the appliance or discovery means as much to the mechanic arts and to society at large as Moissan's electric furnace, Owens' bottle-blowing machine, Pupin's discovery of the art of reducing attenuation of electrical waves and apparatus or Turner's air brake, to mention a few random items out of hundreds, the committee is empowered to award the Elliott Cresson gold medal and other similar honors.

In general, however, it may be said that these higher awards are for contributions to the world's store of knowledge that the unknown inventor rarely makes with his first achievement. To obtain the committee's certificate of merit it is not necessary that the inventor be a distinguished man of science. And from the financial point of view this certificate is just as valuable to him as the Franklin Medal, which is awarded to scientists of international repute like Marconi, one of the winners last year.

Publication of the award is made in the journal of the institute, with the result that within a few months the invention is brought to the attention of every large corporation in the world maintaining a research laboratory, every organization of scientists and all the best technical schools and colleges. The records of the institute show that by far the greater proportion of the discoveries recognized by its Committee on Science and the Arts or its predecessors in ninety-six years have come into wide commercial usage within a relatively short time. With the approval of the experts on this committee for his achievement it is no exaggeration to say that the inventor may make his own selection of capital offers, instead of being compelled to spend his time seeking to enlist financial aid.

Only one thing is necessary for the inventor who seeks this approval—he must have something of real value. It is not essential that it be in use. For obvious reasons, the institute will not consider an invention until a patent has been granted, nor will it act where a patent is in litigation except where this action will not infringe on the rights of either party. The regula-

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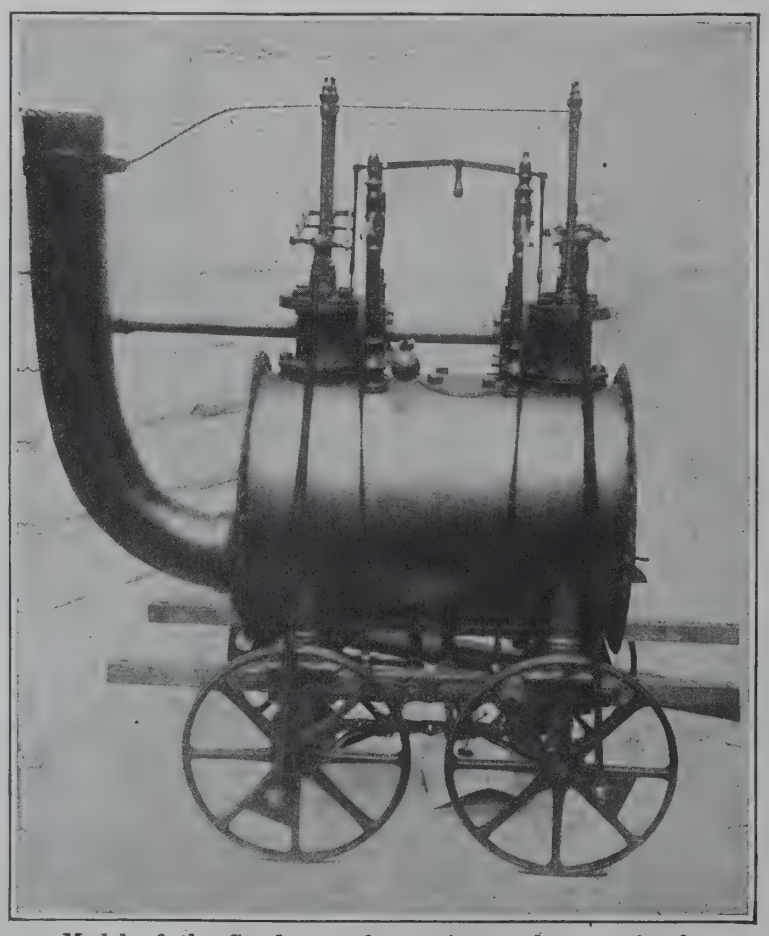
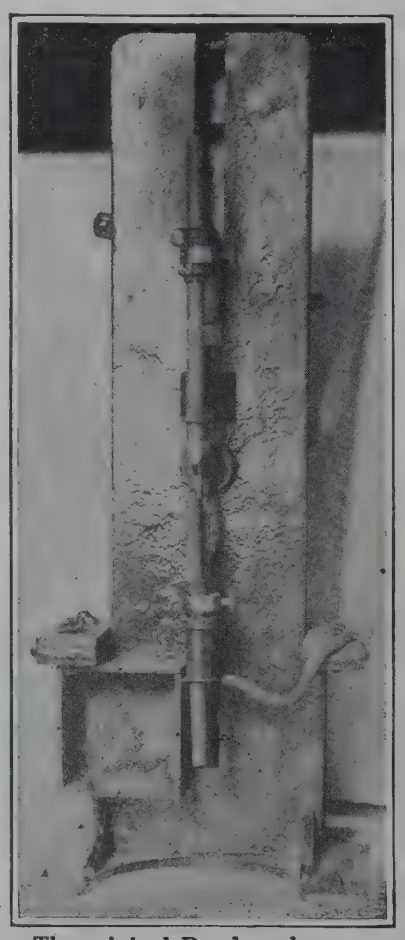


**Model of the Stephenson locomotive, to be seen in the Franklin Institute museum**



**The original Brush carbon arc light**

Copyright Keystone View Co.
**Three views of the miniature circus, showing the owner and the menagerie, interior of big top, and a bird's-eye view of the entire plant**

## The Circus in Miniature

OF miniature sailing vessels, steamers, electric and steam locomotives, houses, gardens, skyscrapers and so on, there seems no end. But when it comes to the circus in miniature, it appears as though we have hit upon something a little out of the regular run of model work.

Here is a young model maker who has constructed a remarkable miniature circus. The first of the accompanying views shows the menagerie tent and the owner of the show, together with some of the cages. The present plant has 60 wagons all told, including baggage, parade, official, cages, and so on. The owner plans to increase his circus to 85 wagons for the 1921 season.

The second view shows the interior of the big top. The center poles are 16 inches high. This tent contains a hippodrome track, three rings, two stages, and aerial apparatus. There are general admission seats, reserved seats, and a grandstand. Three hundred stakes are required to hold this tent.

The third view is a bird's-eye view of the entire circus. In the immediate foreground is the side show. Beyond it is the marquee, or entrance, which leads into the menagerie tent. At the right is the big top, which measures 6 by 12 feet. Other tents are the horse or stable tent, dressing tent, two smaller private dressing tents for star performers, blacksmith tent, cook-house and dining room.

## The Voice with the Megaphone Wins

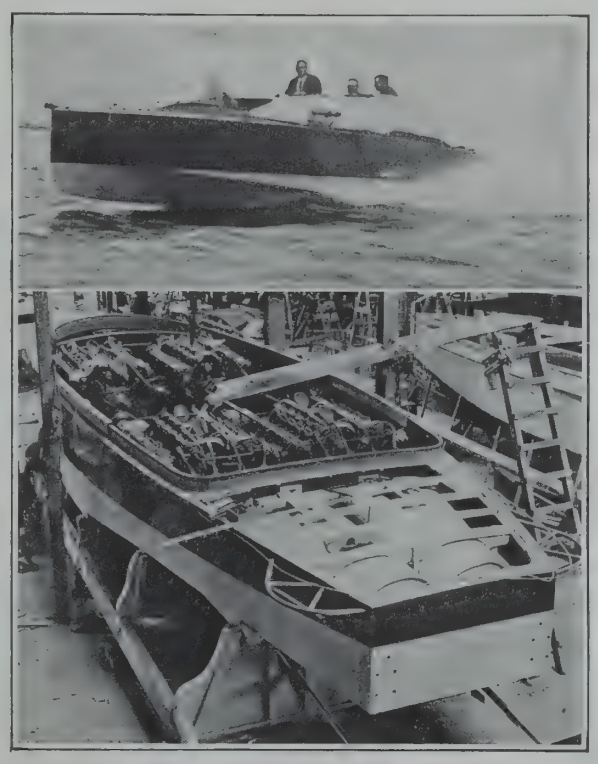
REMARKABLE progress has been made ever since the Liberty and Victory Loan drives in the art of addressing large gatherings. Not so many years ago a public speaker was limited to a crowd of but a few thousand persons when speaking in the open air. Today, thanks to the various amplifying systems and loud-speaking telephones now being employed, a speaker can address 50,000 persons without difficulty.

A remarkable installation of loud-speaking telephones and megaphones is shown in the accompanying illustration. Here is the speaker's stand recently built in Boston for political purposes. The speaker's voice is gathered by an arrangement of microphones in front of him, amplified by vacuum tube circuits, and propagated by means of the loud-speaking telephones and megaphones in all directions. This system of centralized distribution is generally better than the method making use of numerous scattered loud-speaking units.

**A speakers' stand suitable for addressing 50,000 persons in the open**

## The Highest-Powered Motor Boat Afloat

IT will be remembered that one of the contestants built for the Harmsworth Cup races was "Maple Leaf V," owned by Sir E. M. Edgar. In the races she was piloted by H. G. Hawker, who, it will be remembered, made an unsuccessful attempt to fly from Newfoundland to Ireland. We publish these pictures of the boat because of the enormous power plant which was



**Two views of the "Maple Leaf V," which has a combined horse-power of 1,800**

crowded into her; for although she is only 39 feet in length, it was found possible to crowd into her four 450-horse-power Sunbeam engines, together with the tanks of large capacity which were necessary to carry the fuel. One of our pictures shows the four engines placed in pairs side by side. So big was the power plant that it was difficult to find room for the crew's quarters.

The "Maple Leaf," in spite of the fact that she carried twice the horse-power, was easily beaten by "Miss America," which on a length of 26 feet carried only two Liberty engines of a combined horse-power of 800, or less than half the horse-power of "Maple Leaf V." The best speed made by "Maple Leaf" was during her trials, when she reached 62.4 miles per hour; "Miss America" was credited with having made 71.4 miles per hour and was much easier to handle when racing than her rival.

## A New Engine

A LA RHONE engine, made of Sheffield steel, has been presented to the Sheffield University. W. H. Allen, the donor, stated that the engine, although of French origin, is to be made in England by request of the British Government, and the output has been increased from 3 to 50 a week. Altogether 3,000 La Rhone engines have been turned out by the British manufacturers.

The engine is a 9-cylinder rotary type, weighing less than 3 pounds per horse-power. The purpose of the engineers is to produce an engine developing 2.5 horse-power per pound of weight. The La Rhone engine is said to be of startling design. At 1,300 revolutions per minute it develops 100 horse-power, though it can stand on a small drawing table. Dr. Ripper, of the engineering department of Sheffield University, predicts that the next step will be the development of a gas turbine running at a higher revolutionary speed with greatly reduced weight per horse-power.

## Front-Wheel Drive

A MOTOR car improvement, which makes possible the driving of the car from the front instead of the rear wheels, has been invented by G. I. Hoskins, of Sydney, Australia. J. I. Brittain, American consul at Sydney, gives an account of the invention in a report to the State Department.

Mr. Hoskins claims that his invention is a positive success and prevents skidding. A test over 16,000 miles of rough road has been made, it is claimed, with no signs of wear. A number of patents have been taken out.

The front wheels are pivoted in the center, which enables the steering of the car with much greater ease than in the rear-wheel-driven machine. The device is now attached to an old worn British car which, prior to the attachment of the device, weighed 32 hundredweight, with a speed of 38 miles an hour, traveling 15 miles on one gallon of gasoline. After alteration and application of the front drive device, the car weighs 35 hundredweight, has a speed of 45 miles an hour and will go 17½ miles on a single gallon of gasoline.

## An Interesting Pole Construction That Turns Transmission Line

AN interesting pole rack has been constructed for turning a transmission line along the St. Joseph River in Michigan. Spanning the river at this point the transmission line is supported on one side by strain insulators attached to the hydro-electric power house and by a rectangular tower on the other. The lines are turned parallel to the river a short distance beyond the steel tower by means of a wooden tower of four poles formed in a square. A strain tower was erected beyond the corner tower so that the main line strains would not be carried by the wooden structure. The corner tower is, in reality, only a support of splices between the lines running at right angles from this point. Each arm supporting a conductor is guyed back to a short stub pole set and anchored beyond the corner tower, and not shown in this view.

**This wooden structure serves to support the power cables at the point where they turn**

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*

Copyright, Keystone View Co.

**Serving as a side car, the canoe may be transported anywhere in quick time**

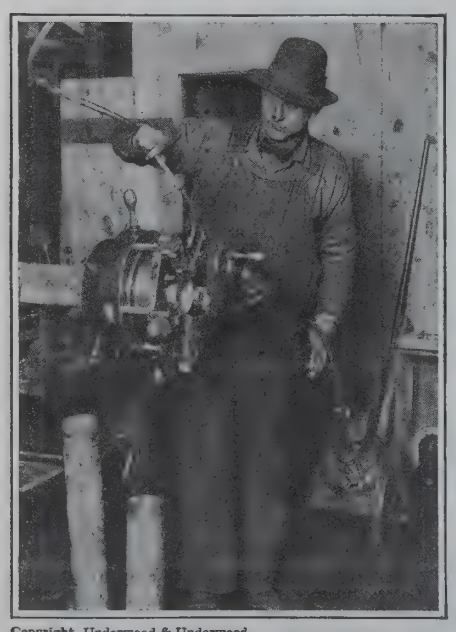
## A Canoe That Goes Anywhere

SOMEWHAT out of the ordinary is the canoe-carrying motorcycle shown in this photograph which comes to us from England. An ingenious young man, Mr. Armstrong, who served in the Royal Air Force as an experimental airman, designed and constructed the arrangement shown in this picture for the purpose of carrying his canoe to distant waterways. The canoe, it will be noted, also serves as a side car for carrying one or two passengers and luggage. An arrangement of helical springs makes this exceptional side car easy riding.

## Taking the Hard Work Out of Threading Pipe

AT best, and that means with the finest tools hitherto available, the threading of large pipes has been a slow and laborious kind of work. The necessity of doing this work "on the job" has prevented the introduction of the usual machinery, and the workers have had to cut threads with stock and dies.

Now comes a Toledo, Ohio, concern with an electrically-driven machine for threading pipe. This machine, which is shown in the accompanying illustration, is a highly portable affair so that it can be used "on the job," even when said job is a relatively small one. The machine consists of an electric motor mounted on a two-wheeled truck, a suitable transmission system which can be adjusted to work at any angle, and the screw-cutting member. It is said that a 12-inch thread which would take two hours and two men to cut by hand, is now completed with this machine in 15 minutes and with one man.



Copyright Underwood & Underwood

**Electrically-driven thread-cutting machine which does the work of two men in one-eighth the time**

## A Household Ladder That Is Never in the Way

EVERY household requires a ladder. Unlike most other pieces of furniture or equipment, the ladder is required only once in a while, but when it is required the need for it is so great that serious inconvenience results in the absence of it. Again, when it is not required, which means something like ninety-nine one-hundredths of the time, it must not be in the way.

With those facts recalled to our attention, we are ready to appreciate the ingenious ladder recently developed by an American inventor. This ladder may be completely folded up and fastened to the back of a closet door, as shown. When set up, ready for use, it is exceptionally rigid so that the housewife need not fear using it. Unlike the usual convertible chair and ladder, which, while it serves two functions, is a poor chair, the new ladder remains rigid and outlasts several of the former.

**This little ladder is exceptionally strong and rigid, yet may be folded flat and fastened behind a closet door, out of the way**

## Discovery of Iron Ore in Switzerland

THE Federal Council officially states that the Society of Study, founded in 1918 at the instigation of the Federal Department of Economics, has by explorations and excavations in the Frickthal, a valley in the northern part of the Canton of Aargau, recently discovered an area of 190 hectares (hectare = 2.47 acres) containing 15,000,000 tons of iron ore. In the immediate vicinity, not yet surveyed and excavated, there is estimated an additional amount of 22,000,000 tons. One can realize the importance of this discovery, it is stated, if it is understood that these millions of tons will assure to Switzerland, at pre-war consumption rate, sufficient iron ore to last for 45 years. The Federal Council suggests a provision by the Government of 1,200,000 francs upon condition that a total capital of 4,000,000 francs is raised for exploitation.

## A Clock That Speaks For Itself

FOR seven years Mr. H. Hartmann, a New York inventor whose name is no doubt familiar to many of our readers by reason of his several past inventions which have been described in these columns, has been using the clock shown in the accompanying illustration. So it is apparent that this clock has a rugged and lasting mechanism, and is out of the experimental class.

The clock in question is a speaking clock; that is to say, it speaks every fifteen minutes, announcing the correct time. The voice record is carried on a band of film which is perforated in much the same manner as the standard motion picture film. A conventional phonograph reproducer is used to translate the latent sound record into actual sounds. Pressing a button causes the clock to repeat the time, while another button keeps it silent. The clock is only 16 inches high, 10 inches wide, and 9 inches deep.

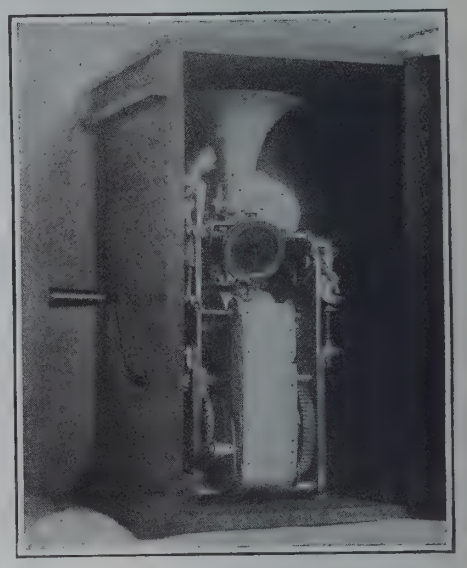
## Barrels Made of Paper

FARMERS and manufacturers have felt the ever-increasing cost of barrels, and it has been pointed out on more than one occasion that barrels are playing no small rôle in the general high-cost-of-living scheme.

For some time inventors have been at work on the barrel problem with a view to producing cheaper containers. Several of them have tackled the paper barrel problem and it appears as though their work has finally materialized into something of practical value. These paper barrels are generally made in the form of many layers of stiff paper, held together by some suitable adhesive which may also be watertight and weatherproof.

The barrel shown in the accompanying illustration is made by a winding process employing chip board, and is said to cost one-third less than a wooden barrel of equivalent size. The inventor also claims greater strength for this paper barrel.

Paper cans and other containers can be made of wound paper, and no doubt much will be done along this line in the near future.



**This clock has neither dial nor hands; it speaks the time like a phonograph**

## Commercial Aviation in England

IN the fifteenth annual report of the British Meteorological Committee plans were brought forward to secure a comprehensive service of weather reports to facilitate commercial aviation and to forecast accurately aerial conditions affecting the London-Paris-Brussels service.

The plan has in its purview the establishment of approximately 20 distributing centers, staffed by trained meteorol ogists, who will provide regular information covering the following points:

1. Wind at surface and at 2,000 feet
2. Weather (present and past in general terms).
3. Amount and height of any low cloud.
4. Visibility.
5. (For seaplanes.) The state of the sea, particularly in regard to the nature and amount of the swell, which affects the power of a machine to rise.

During the past month the Swedish post office has announced a regular air service from Stockholm to Malmo, Copenhagen, Hamburg, Bremen, Amsterdam, and London, and the service known as the London-Copenhagen Air Mail, recently inaugurated for service to London via Hamburg and Amsterdam, with Copenhagen as starting place, will accept express letters for distribution in the afternoon following the morning of departure at Berlin and Hamburg, and at night in Amsterdam, while express letters will be delivered in London at 2 P. M. on the following day and ordinary letters a few hours later.

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**Eleven-gallon barrel made of paper and costing one-third as much as a wooden one**

## *"If we only had thought of that before we built!"*

TOO often such a wish occurs to the new home owner after the house is occupied. A change then is less satisfactory and more expensive. So it behooves the home planner to anticipate the electrical features that mean so much convenience, comfort, and housekeeping happiness.

A floor plug here or a switch there built in where it is needed —these are so little, so inexpensive, but so all-important.

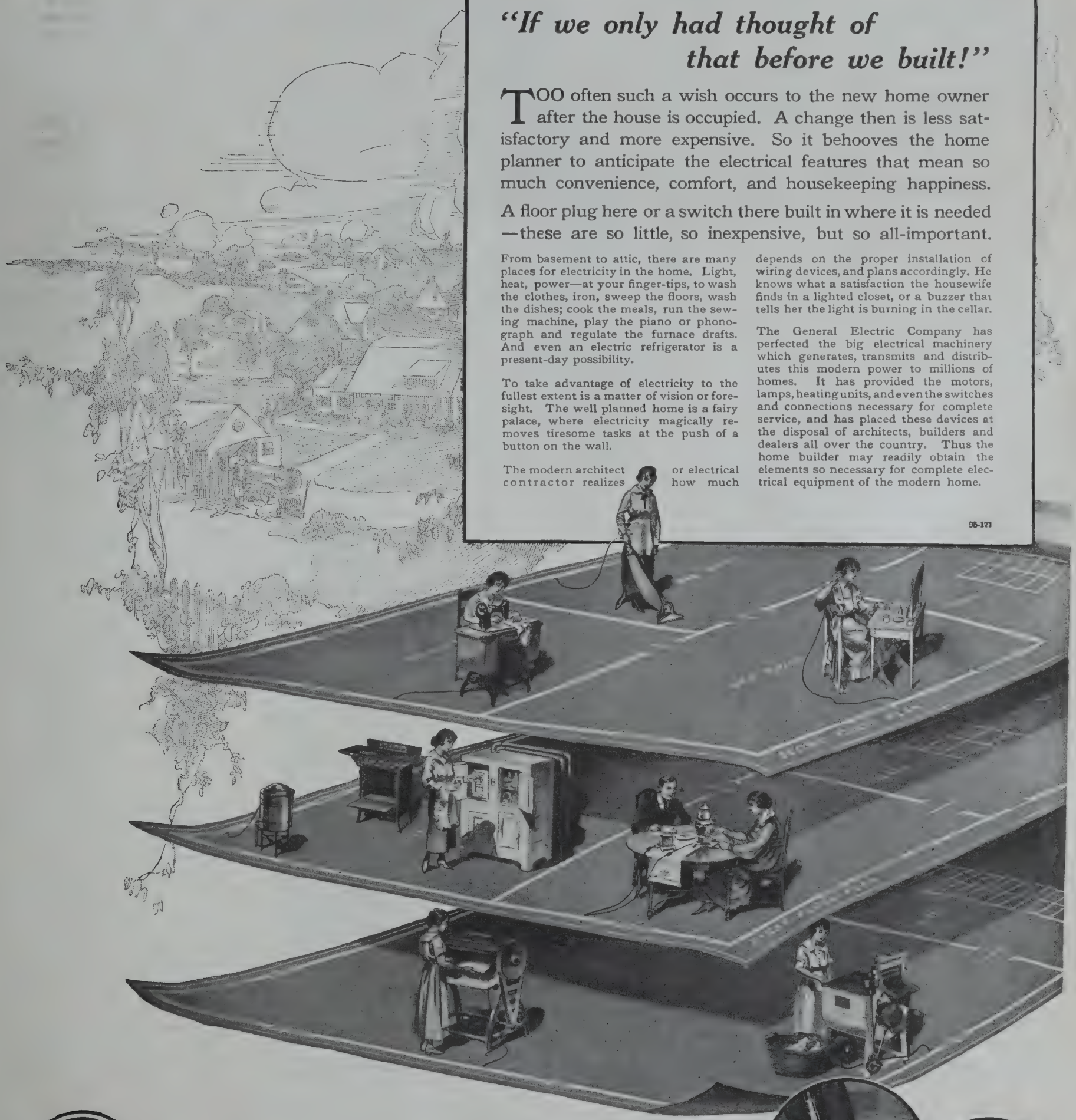
From basement to attic, there are many places for electricity in the home. Light, heat, power—at your finger-tips, to wash the clothes, iron, sweep the floors, wash the dishes; cook the meals, run the sewing machine, play the piano or phonograph and regulate the furnace drafts. And even an electric refrigerator is a present-day possibility.

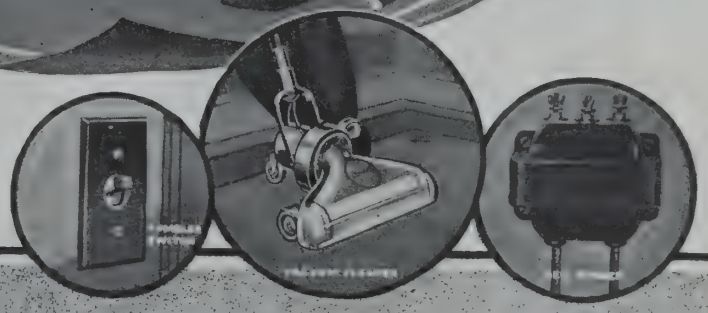
To take advantage of electricity to the fullest extent is a matter of vision or foresight. The well planned home is a fairy palace, where electricity magically removes tiresome tasks at the push of a button on the wall.

The modern architect or electrical contractor realizes how much depends on the proper installation of wiring devices, and plans accordingly. He knows what a satisfaction the housewife finds in a lighted closet, or a buzzer that tells her the light is burning in the cellar.

The General Electric Company has perfected the big electrical machinery which generates, transmits and distributes this modern power to millions of homes. It has provided the motors, lamps, heating units, and even the switches and connections necessary for complete service, and has placed these devices at the disposal of architects, builders and dealers all over the country. Thus the home builder may readily obtain the elements so necessary for complete electrical equipment of the modern home.

95-171





GENERAL ELECTRIC COMPANY

# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

## Pertaining to Apparel

GARTER.—P. E. ROSEN, 117 W. Main St., Madison, Wis. The invention has for its object to provide a device especially adapted for men's use, wherein the garter consists of a strip of non-elastic material having at one end a clasp for engaging the hose and having near the other a loop through which the clasp is adapted to be passed to form a sliding loop for encircling the leg at the knee to provide a support which will accommodate itself to the movement of the muscles to properly support the hose.

## Pertaining to Aviation

GIRDER AND THE LIKE FOR AIRCRAFT.—E. E. BROWN, c/o D. J. Mooney, Steel Wing Co., Ltd., 48 a Gallingham St., London, S. W., 1, England. The invention has for its object to provide a metal girder or equivalent structure for aircraft which shall be very stiff and stronger in proportion to its weight. The girder comprises composite channel members placed back to back, characterized by the web portion being provided with parallel ribs which are set obliquely to the longitudinal direction of the girder, the ribs of one channel member being sloped in the opposite direction to those of the other which increases the parallel resistance.

METAL CONSTRUCTION.—E. E. BROWN and D. J. MOONEY, c/o The Steel Wing Co., Ltd., 48 *a* Gillingham St., London, S. W. 1., England. The invention relates to a metal frame device for use in connection with airplanes. An object being to provide a spar composed of sheet metal which will embody the maximum of strength and at the same time be as light in weight as is possible consistent with the use.

## Electrical Devices

RELAY ARMATURE.—J. I. MITCHINER, 78 S. Pryor St., Room 401, Atlanta, Ga. An object of this invention is to provide a telegraphic relay armature of such a construction that two or more electrical contacts are simultaneously made in separate circuits upon the energization of the relay magnet. Another object is to provide an armature by which the making of one contact in each of two separate circuits simultaneously is enabled to be made without the aid of supplementary springs.

DEVICE FOR ATTACHING ELECTRIC LIGHT FIXTURES TO OUTLET BOXES.—R. BATTLE, Box 859, Okmulgee, Okla. This invention has for its object to provide a device of the character specified, so constructed that the fixture, as for instance a light or fan, may be readily removable for inspection, repair, interchange, cleaning and the like, and adapted for use on either ceiling or side wall.

LAMP FIXTURE.—J. S. PENNEFATHER, 500 W. 144th St., New York, N. Y. The invention relates more particularly to an adapter used for the purpose of converting a vase into a base for supporting an electric light and shade fixture. An object is to provide an adjustable adapter to fit various forms, shapes, sizes, and heights of vases, which may be readily mounted upon a vase, and which will be ornamental in appearance.

## Of Interest to Farmers

CULTIVATOR.—R. L. GUTHRIE, R. 3, Box 409, Santa Rosa, Cal. This invention relates particularly to hand-operated cultivators of the wheel type, an object being to provide means for connecting the standards and braces of the structure to the frame supporting the same, whereby the parts may be easily and quickly adjusted or rearranged to perform the desired functions.

MAIZE OR INDIAN CORN HARVESTING MACHINE.—E. LOGARZO, Buenos Aires, Argentina. The invention is characterized by the special construction and arrangement of the husking means constituted substantially by a pair of biconical cylinders placed at an angle, and the surface of each of which is grooved or fluted in parallel direction of its axis, or in a helicoidal direction. The movement of the machine is obtained by means of a gearing driven by the axle of the transportation wheels.

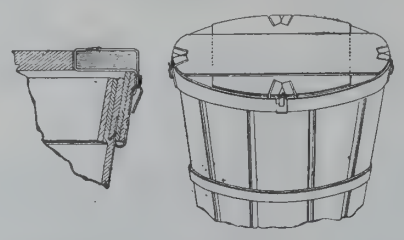
## Of General Interest

LIFEBOAT.—G. DORFFEL, 2141 S. 47th St., West Seattle, Wash. The invention relates to lifeboats or escape buoys for use with submarine vessels. The object is to provide a device which can be easily and quickly launched, which is carried in position by the submarine vessel so that interior access can be had at all times before launching, and which will not unfavorably affect the normal operation or maneuvering of the submarine vessel.

COFFEE POT.—W. H. BRUNING, 100 Upper 1st St., Evansville, Ind. Among the objects which the invention has in view are to avoid radiation of heat during the process of making coffee, and of radiation of heat from the coffee subsequent to the making thereof, to distribute water poured over the prepared coffee, to equalize the filtration thereof, to provide means for maintaining by diffusion the heat of the liquid coffee, and to construct a coffee pot arranged to afford easy access for the purpose of cleaning.

PRODUCT IMITATING CHINA.—C. BUTTY, Calle Maipu 671, Buenos Aires, Argentina. This invention is adapted to be used as an imitation of china, marble and the like; it is not affected by acids or changes in weather, and in consequence is particularly suitable for the manufacture of buttons, insulators, objects of art, etc., and other articles not destined to get in contact with fire. The composition is as follows: Sulfur, 40 per cent; clay or Roman cement, 60 per cent, and a coloring matter.

BASKET FASTENER.—J. F. KENNEDY, 9 Laurens St., Charleston, S. C. The invention relates generally to fruit and vegetable baskets and more particularly to the fastenings thereof, an object being the provision of a



A PERSPECTIVE VIEW OF BASKET WITH COVER SECURED

simple and inexpensive means capable of ready use without the necessity of driving fasteners in the basket cover, as well as a fastener which may be speedily applied and will be effective in use.

COMBINED PERISCOPE AND GUN.—L. HOLECEK, 652 7th Ave., Oakland, Cal. An object of the invention is to provide a combined periscope and gun for submarines, to permit of accurately swinging the gun to correctly aim the gun at a distant object as seen through the periscope. Another object is to permit of firing the gun when the submarine is in submerged, raised or awash position, and to permit the gunner to swing the gun up or down to obtain the desired elevation or depression.

PURSE.—W. STONE, 66 W. 36th St., New York, N. Y. An object of the invention is to produce a coin purse made in conjunction with a hand bag and thus combining the advantages and facilities of both, a large hand bag and a small coin purse. One of the primary objects is to provide against the necessity of carrying both hand bag and coin purse in order that a lady may be equipped with an article which will materially facilitate the payment of car fares and other small change in crowded places.

## Hardware and Tools

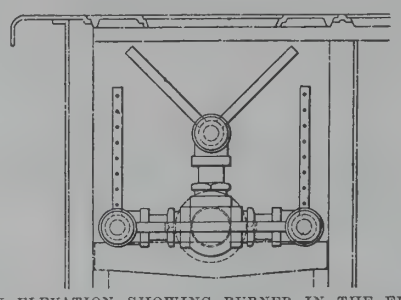
MILLING CUTTER.—W. A. JAMES, c/o Ellis Spear, Jr., Tremont Bldg., Boston, Mass. A specific object of the invention is the provision of a milling cutter in which certain of the tool elements are set at an angle to the axis of rotation, while others are parallel with the axis, so that when the disks are moved axially, one with respect to the other, all the disks are effectively clamped or unclamped.

CENTERING PUNCH.—H. M. WALKER, Benford, Texas. This invention has for its object to provide a device having means for permitting the punch to be accurately centered in an opening of a pattern plate for instance, to insure that the punch will engage the work at the exact center of the opening, and wherein the punch is adjustable for openings of various sizes.

OVERSHOT.—R. A. DAILEY, c/o Honolulu Cons. Oil Co., Taft, Cal. The invention has for its object to provide a device adapted for fishing broken tools from a well casing, wherein a body portion is provided having slips or dogs for engaging the tool to hold the same, together with various types of interchangeable bowls for facilitating the engagement of the overshot with various characters of break.

## Heating and Lighting

GAS BURNER FOR HEATERS.—R. DEPEW, 1485 DeKalb Ave., Brooklyn, N. Y. The object of the invention is to provide a gas burner for use in the firebox of a kitchen range, house-heating furnace and similar heater, and arranged to insure the production



AN ELEVATION SHOWING BURNER IN THE FIREBOX OF A KITCHEN RANGE

of a high heat with an exceedingly economical consumption of gas. Another object is to provide a gas burner of simple construction which can be readily installed in a firebox without requiring alteration of the same.

## Machines and Mechanical Devices

COAL HANDLING MACHINE.—E. N. WEAVER, 98 Columbus Ave., Jersey City, N. J. Among the objects of the invention is to provide mechanism for rapidly handling, sizing, and transferring bulk material such as lump coal in regulatable quantities from one ship or conveyance to another, as for instance, in the rapidly coaling of ships through a chute into the lumber hatch, thus dispensing with the necessity of employing many laborers.

CARGO HANDLING APPARATUS.—J. G. GUNN, Cherokee, Iowa. An object of the invention is to provide a cargo handling device by means of which cargoes may be quickly and easily transferred from place to place and the cargo dumped or unloaded expeditiously in any place and manner desired by the mere operation of a crane or other lifting device employed.

STEAM CIRCULATING BY-PASS AND RELIEF VALVE.—E. B. WHELAN, 1025 S. 10th St., Omaha, Neb. The invention relates generally to valves for steam engines, especially locomotives and particularly to valves which function as by-pass and vacuum and compression relief-valves, the object being the provision of an arrangement whereby low pressure steam is positively circulated through the cylinders when a locomotive is drifting for the purpose of lubrication, in addition to the usual functions of a valve of this type.

MOTOR.—J. SCHROEDER, 1624 W. 7th St., Davenport, Iowa. An object of the invention is to provide a valve gear comprising a shaft and means for turning the shaft in opposite directions, a crank disk loose on the shaft, means for compelling the disk to turn with the shaft during a portion of the rotary movement in both directions, a spring operatively connected to the disk and compelling the latter to complete its movements, a valve operating crank arm, and a rod connecting the disk and crank arm.

## Musical Devices

SOUNDING BOARD FOR MUSICAL INSTRUMENTS.—J. VIRZI, 341 E. 124th St., New York, N. Y. The invention has particular reference to sound boards for such instruments as violins, violas, cellos, pianos or the like in which there is ordinarily used a sound board as a means amplifying the sound vibration. Among the objects is to provide an auxiliary sounding board arranged in spaced relation to the main sounding board of the instrument and having the periphery thereof disconnected from all other parts of the instrument.

ARTICULATOR FOR PHONOGRAPHS.—F. B. LONG, 833 Market St., San Francisco, Cal. The object of the invention is to provide the sound chamber of a phonograph into a sound board of a highly vibrant material and subjected to edgewise pressure to form a crown on the sound board with a view to insure perfect vibration. Another object is to throw back upon the sound board the molecular vibrations emanating from the sound board.

## Prime Movers and Their Accessories

ATTACHMENT FOR INTERNAL COMBUSTION ENGINES.—W. E. STITZER, Box 299, Muskogee, Okla. The object of this invention is to provide mechanism for use in connection with lubricator and controller by the level of the oil in the lubricator, for stopping the motor when the oil falls below a predetermined level, by short circuiting the ignition system.

VALVE SPRING COMPRESSOR.—F. E. JENKINS, 121 Kenwood Ave., Medford, Ore. The invention relates to tools for compressing valve springs of automobiles, airplanes, or other gasoline motors; its object is the provision of a device adapted to be engaged upon a valve spring to be compressed and so constructed that after the device is initially set in position it will automatically compress the valve spring.

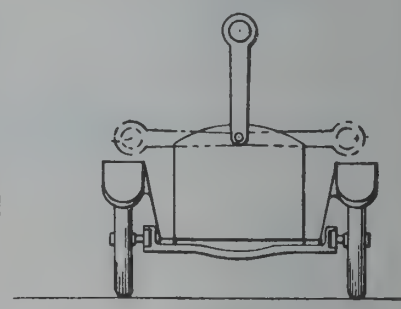
## Pertaining to Recreation

PLEASURE RAILWAY.—M. JOHNSON, 249 56th St., Brooklyn, N. Y. Among the objects of the invention is to provide a pleasure railway for parks, exhibition grounds, fairs and other places of amusement, and arranged to accommodate a large number of persons at a time, and to provide an exhilarating ride for the participants. A further object is to provide a pleasure railway which is simple and durable in construction and safe in operation.

TOY.—E. W. TRAUTMAN, Gulfport, Miss. The invention has for its object to provide a device wherein the toy has the outline of a vessel, as, for instance an airplane, torpedo, or ship, and is provided with a supporting pulley adapted to run upon a cord to which the toy is swiveled, the toy having guiding vanes and a propeller, and means for exploding a torpedo when it strikes an obstruction.

## Pertaining to Vehicles

DIRECTION INDICATOR.—J. E. MAYHALL, 1216 Madison Ave., Covington, Ky. The primary object of the invention is to provide a convenient means for facilitating driving a vehicle, preferably a motor vehicle in a congested city or in fact anywhere it is desira-



A FRONT VIEW OF VEHICLE WITH DEVICE ATTACHED

ble to give a warning to a vehicle either approaching from the front or rear, the direction which the vehicle or which the indicator is installed is to take, the device being conveniently operated by the chauffeur.

TIRE HOLDER.—A. F. ENGEL, 650 Wayne Ave., Defiance, Ohio. An object of this invention is to provide a tire holder such as is commonly carried on motor vehicles and which permits ready insertion or removal of the tire. A further object is to provide a holder which can be swung to one side to provide a free entrance or exit for the tire, and which when moved into position and locked, will securely hold the tire against accidental movement.

## Designs

DESIGN FOR A KNIFE SHARPENER.—T. C. CURLEY, 87 Duane St., New York, N. Y.

DESIGN FOR AN ARTICLE OF MANUFACTURE, NAMELY, A PILLOW OR ARTICLE OF A SIMILAR NATURE.—M. D. DREYFACH, 482 Broome St., New York, N. Y.

We wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject-matter involved, or of the specialized, technical or scientific knowledge required therefor.

We also have associates throughout the world, who assist in the prosecution of patent and trade-mark applications filed in all countries foreign to the United States.

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## The State and the Farmer

(*Continued from page 494*)

details of farm improvement and farm methods have been carried out under the advice of the Board's experts, free to the settlers. Nothing in the community has been done in a loose or haphazard manner and under this *modus operandi* a model farm community was evolved in less than one year.

In the meantime practical farm development was taken up, soil maps consulted, fields, orchards and gardens laid out, and crop production arranged. The Board has made itself the friend and counselor of each settler, and has been unstinting in advice as to the planting of crops, purchase of live stock, tools, equipment, seed, etc. It also gave valuable advice in the organization of coöperative buying and selling organizations among the settlers; the construction of an extensive scheme of roads, drains and irrigation works; as well as advising the farmers as to the best methods of leveling, checking and smoothing their lands and the preparation of seed beds and the planting of seed.

In order that no time be lost in the production of crops the first year the Board helped the farmers by having a big outfit to prepare land for seeding and irrigation and actually to put in crops of barley, oats and wheat, taking the pay for the work out of the crop.

Here are some of the net returns to individual settlers from some of these crops: C. W. Baker, fifteen acres of oats, $105; E. O. Messenger, eighteen acres of barley, $368.28; William Deveney, 20 acres of barley, $66.10; Carl Neilson, eighteen acres barley, $476.75; A. I. Maxwell, 12 acres barley, $313.40; E. E. Will, 47 acres barley, $696.38; Jos. N. Thornton, 54 acres wheat, $624.50; Frank M. Hall, 47 acres barley, $955.15; Roy White, 60 acres barley, $1,390.50.

The survey and mapping of the settlement land were based largely upon the story told by the soil map. Samples of soil were taken at such intervals as was necessary to make an accurate map of the whole area.

With this in hand the sizes of the farms were determined so as to give considerable choice to intending settlers, keeping each farm within such limits that one family, with the help of one farm hand, could take care of it.

Consequently the farms suited to fruit-growing were made small, while the lands suited to farm crops were laid out in larger units, running as high as 160 acres. In some cases a tract of grain land went with a small tract of fruit land, say, 15 or 20 acres, the two tracts sometimes not being contiguous.

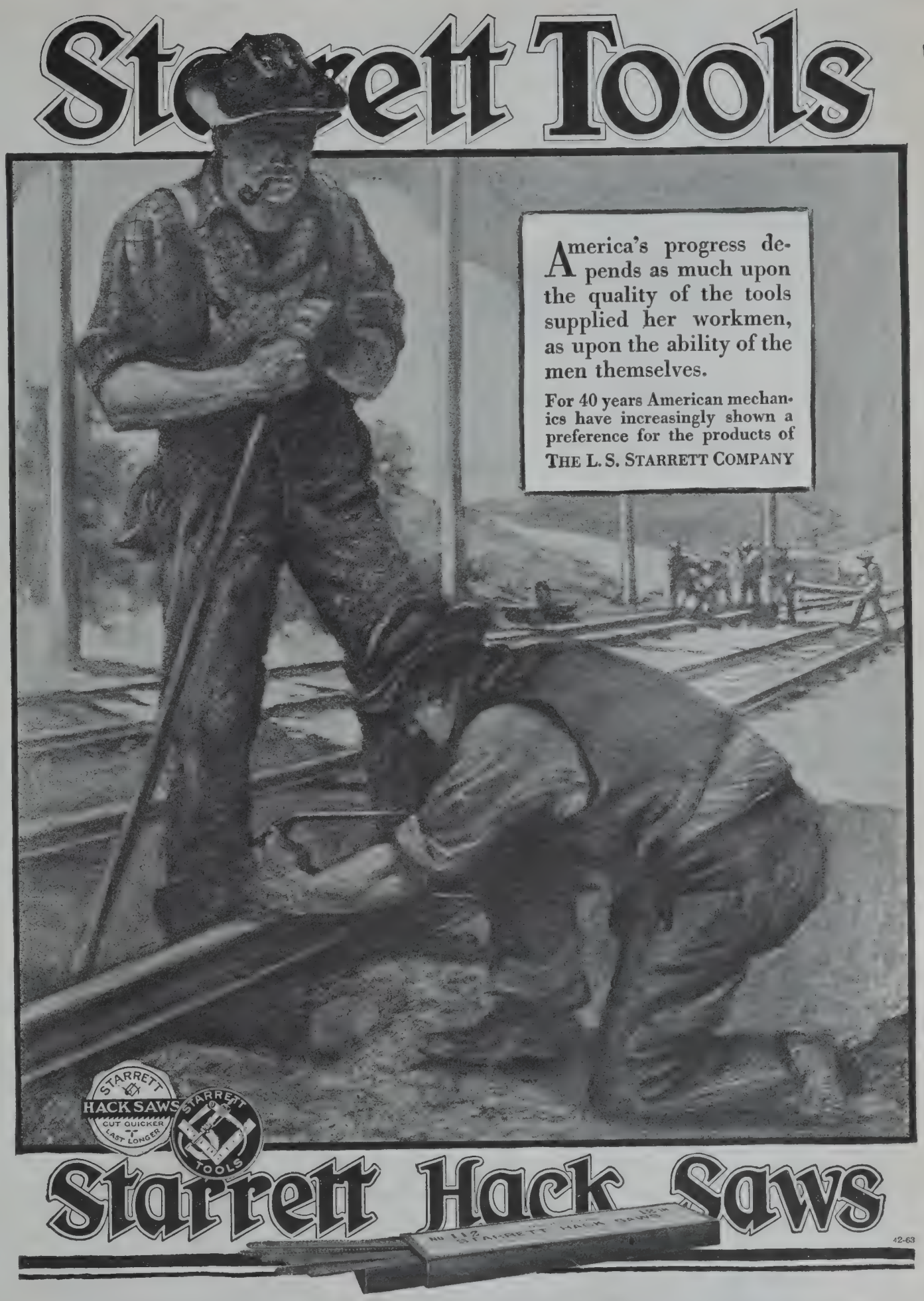
The State Land Settlement Board was not insensible to the social needs of the community, consequently it set aside a fine tract of 22 acres as a community center. It is planned to erect upon this plot a community hall where different social and business organizations will find meeting room. There will also be laid out and equipped athletic grounds where the boys may play baseball and the girls lawn tennis. Upon this community center is a fine grove of native oaks where picnics are held. It is also the intention of the board to establish on these grounds a vocational school.

Thus Durham has been made a model rural community. It is benefited not only by the paternal influence of the State but by the fraternal character of the settlement.

The State not only supplies financial backing for the settlers, but it educates them in the most up-to-date farm practices. It has inaugurated both a system of collective buying and of collective selling, thus insuring the settlers against the wiles of sharpers and profiteers.

The settlers themselves become imbued with agricultural ambition and pride. The close intimacy of the settlers begets a common feeling of fraternity.

The concentrated nature of the popu-




### Selecting the Right Make of Hacksaw

"As the saw, so is the reputation of its maker. Nothing but the best in composition of material, heat treatment and the greatest accuracy in cutting, spacing and setting the teeth will give the best results, no matter how skillfully the blade may be used. And, vice versa, no matter how high the quality of the saw, economy of or in operation cannot be secured if the blade is put to uses other than those for which it was intended by the maker, or if certain fundamental facts are overlooked."

### The Essentials of an Efficient Saw

In selecting a Hack Saw, three objects should be kept in mind:

(a) The blade must cut fast.

(b) The blade must do the maximum amount of work at the minimum combined cost of the saw itself and the labor and overhead chargeable to the operation.

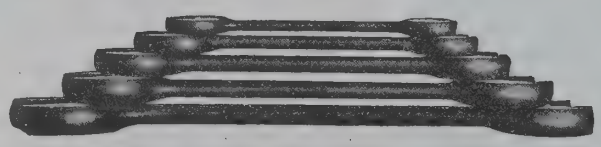
(c) The blade must be suited for use on the largest variety of materials possible without interfering with "a" and "b."

### A Practical System of Blade Selection

"Any system of blade selection to be really practical must be based wholly on the material to be cut, rather than on any classification of blades according to a list of trades or an arbitrary classification by number. Were it possible to say that in any particular trade only certain classes of material were cut, such a classification would be ideal; but, dividing the metals according to their influences on cutting speed, saw life, etc., which is the only true basis to use, it is practically impossible to say that any given trade will have occasion to cut only a definite portion of the list. Efficiency is best served by classifying the various materials, the one group of factors with which every operator, skilled or unskilled, is familiar, and putting opposite the name of each metal the catalog number or designating letter of the saw which should be used.'—from Hack Saws and Their Use, published by The L. S. Starrett Co., Athol, Mass., for free distribution.

**Williams' Superior Drop-Forged Wrenches**

Thin



Standard

Heavy

We've a wrench for every purpose. 40 Standard patterns in stock, in about 1000 sizes, with openings from $\frac{3}{16}$ to $7\frac{5}{8}$ inches.
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lation works for friendliness and sociability, and thus the proverbial dullness of ordinary rural life is done away with and the life of the farmer seems less irksome and burdensome, all of which inures to contentment, happiness and prosperity.

Acting upon the recommendation of Governor Stephens the California Legislature of 1919 appropriated $1,000,000 for continuing the land settlement system, and also authorized a bond issue of $10,000,000 for a like purpose. Under these provisions the State Land Settlement Board has purchased a 10,000-acre tract of farm land in Merced County in the central part of the San Joaquin Valley for settlement in the near future, along similar lines as those governing the Durham settlement. In the settlement of this second tract preference will be given to ex-service men.

## Winter Fuel from Our Woodlands

(*Continued from page 495*)

eastern part of the United States, the owners of those woodlands will not cut and market the wood unless they can sell at a profit. Ordinarily, cordwood is sold only in a district within 5 to 10 miles from where cut, and hauling is done direectly from the cutting area to the purchaser, but where water or railroad transportation is easily available it is possible for the farmers to cut their wood and ship it several hundred miles at a profit.

Cordwood is ordinarily cut into 4-foot lengths, and with a power saw run by a tractor or gasoline engine, a three-man crew can saw up from 10 to 15 cords per day. Splitting is either done by hand or by machinery, for in recent years several types of splitting saws have been invented and it is possible to saw and split the logs by the same crew.

The cost of hauling wood by team will average from 50 to 75 cents per cord per mile, which restricts the area of delivery to a small radius. When shipped by rail, the freight rate for distances of about 10 miles will average from 50 to 60 cents per cord, while the same wood can be shipped a distance of 100 miles by rail at a cost of from $1 to $1.50 for freight. Water rates are, of course, very much cheaper, and by far the larger portion of the 17,000 cords of wood fuel used annually by the City of Washington is brought up the Potomac River on sailing vessels, carrying an average of 30 cords and requiring but two or three men to operate. In loading or unloading from cars or boats one man can handle from 7 to 10 cords of 4-foot wood per day and from 6 to 8 cords of 16-inch wood.

In attempting to solve the fuel needs of communities, various plans have been devised to bring the producer and consumer together. In a number of cities municipal wood yards have been established, where fuel can be brought for sale. One New England city, which was hard-hit by the fuel shortage two years ago, arranged for the purchase and storage of 100,000 cords of farm wood, to be used as a fuel reserve, and in a Southern State there are more than 30 municipal wood yards in operation. A yard established at Durham, N. C., purchased 1,260 cords of wood at an average cost at the yard of $5 a cord, and was delivered to the consumer at an average cost of $7 per cord. The material was obtained from two sources, one, consisting of slabs, from a sawmill about 14 miles distant, and green pine and oak from farm woodlands near by. The slabs, of odd lengths, were purchased from the mill for $2 per cord f.o.b. cars, and were unloaded at the municipal yard, where they were cut up into desired lengths. The freight charges on these slabs amounted to 75 cents per cord. The wood from the farmers' woodlands was cut in 8-foot lengths and split in halves or quarters. The price was $3.50 per cord piled in the woods. It was hauled from the woods to the roadside by country teams, and motor trucks carried it from the roadside to the yard, and the total cost of hauling was about $1 per cord, for the distance of 3 miles from the cutting area. The cost of cutting the wood into stove lengths at the yard was about 50 cents per cord.

A standard cord of firewood is a pile 8 by 4 by 4 feet, or 128 cubic feet of stacked wood. A pile of green wood will shrink two or three inches through settling and drying, and it is customary to pile green wood somewhat higher than 4 feet to allow for this shrinkage. A running cord, or "face" cord, 8 feet long by 4 feet high and 12, 16 or 24 inches wide, according to the length to which it is cut for use, is frequently called a cord in the market. Though a cord contains 128 cubic feet the space occupied includes air as well as wood, and the actual wood content is only about 70 per cent of this amount, or 90 cubic feet of average size. Small, smooth sticks pile closer together, and therefore there is less wood in a cord of crooked sticks than a cord of straight sticks.

## Forewarnings About Forest Fires

(*Continued from page 495*)

Sparks from railroad locomotives which traverse timbered country also cause many destructive forest fires each year. This is displayed by means of a miniature passenger train which runs along the foot of a mountainous slope which is heavily forested. Sparks from the engine fire the underbrush and rapidly the flames climb the hillside. Similarly, fire damages caused by motor tourists who throw lighted cigars, cigarettes or pipe ashes from the automobile as it speeds through a densely timbered territory are also depicted in the mechanical exhibit. These sparks touch off the dry refuse on the ground and directly the flames spread over the adjoining hillsides. From a scientific and mechanical standpoint this novel method of illustrating forest fire causes is extremely meritorious and praiseworthy. Wherever it has been exhibited it has elicited much favorable comment and has resulted in many careless motorists, campers and ranchers reforming their activities as related to camp fire neglect, match use and ignited tobacco disposal.

## Solving the Labor Problem—II

(*Continued from page 496*)

through our classes we help the man train for the job ahead. We point out that we fill our big jobs from the inside, and point out the men at the head who started low. What's more we stick by that policy.

After a man has been with us a month, he receives from the Employment Office a questionnaire headed "Application for Promotion." This outlines our policy of filling big jobs from the inside and asks the man what he is doing to prepare himself for promotion. It asks him what he wants to make of himself, and what he is doing to attain that end. When this is filled out and returned we have a fairly good line on the man and are in position to help him help himself.

We have done two things by this: First, we show him that we are interested in his development and look upon him as the sort of man who wants to stick with us. Second, we have gotten a pretty good analysis of the man, his ambitions, and his possibilities. These questionnaires are filed, together with a man's class record, and are consulted when promotions are being considered.

When you combine work of this sort with an absolute policy of square dealing you have a good basis for labor relations. When you realize that the men who work to build your product must be sold on the plant and its policies, just as your customers must be sold on your product and your policies, then you will have progressed a long way on the road to harmony. Men want to be treated as men. They want you to hear what they have to say about the policies under which they

# PATENTS

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work, and, more than all that, they want to know that you are with them and look upon them as individuals, not accessories to machines.

Now for the pessimism. I always like to include a bit of warning along with the cheerful news.

Don't think that because someone has a plan that works that you can lift that plan and have it work as well for you. It isn't the plan that does it, it's the spirit. Plant spirit cannot be created over night. It does not come as the result of anything but long, hard work on the part of somebody who deliberately lays out a campaign for it.

In our case our campaign of education was running for more than a year before we said anything about any system of employee representation. Our plan came as a factor in a whole campaign to have men understand what they were doing and why. Never has it dominated the situation and we hope it never will.

Your work is never done. Almost every week we have some pamphlet to pass out. We are keeping at it constantly. We believe that the more education a man gets, the more he wants, and we aim to keep him supplied with all the information available on timely subjects.

Remember your workers are the same as you are. They respond to the same treatment that you respond to, and recoil from the same sort of treatment that you would recoil from. Get out in your shops and meet them. Let them meet you. They'll add considerably to your knowledge and you can be of great assistance to them. Tackle this subject together. Tell them what they want to know about the business and let them see the basis under which capital and labor are working in your plant.

Men would rather accept information from you than misinformation from an agitator. The trouble has been that hitherto the agitator has had no competition from those who knew the facts but would not pass them on.

The time has come to change this. Business must sell itself to those who help make it. The workers must be appealed to on the basis of education.

Give your men facts to think with and they'll see the pitfalls in destructive theories.

## Fuel or Fertilizer?

(*Continued from page 498*)

legume crops because when introduced into the soil the proper bacteria to suit the conditions become active. Such inoculants form part of the product of these peat plants. A two-pound can is sufficient to inoculate an acre of ground.

The more general practise, however, is to make of the peat a commercial fertilizer and to inoculate this fertilizer with the bacilli before it leaves the plant. Thus is produced a product that is at once a fertilizer and an inoculant and in addition other strains of bacilli are added which generate plant foods from the decaying vegetable matter in the soils. The result is very nearly a "universal" fertilizer, for there is hardly any soil condition or plant growth that cannot be improved by its use.

It is difficult to say how long peat has been used in making manure. A little book published in 1815 by an anonymous author is entitled "Directions for Preparing Manure from Peat." It seems the author was a wealthy Scotch landowner. Having occasion to excavate a small peat bed in building a lake, he was at a loss to know what to do with the muck. His Scotch thrift, no doubt, suggested the idea that it might make a good fertilizer and he began a series of experiments in a truly scientific spirit. After several years he decided that the best manure was made by mixing common stable manure with about double the quantity of peat, and letting it stand, mixing occasionally. He found that the decay in the peat was apparently communicated to the


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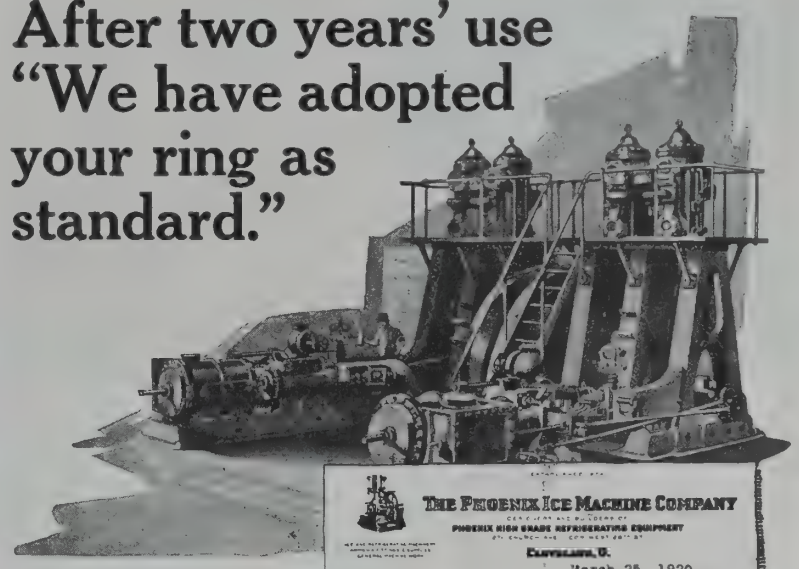

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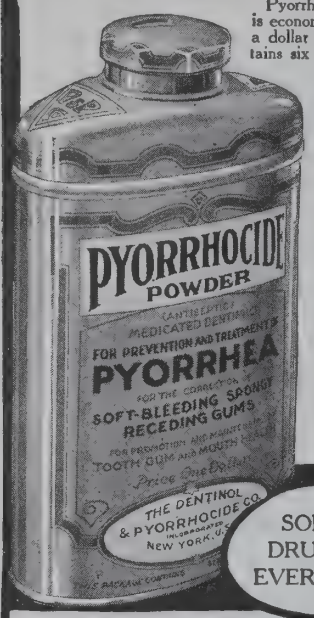


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manure and that he very quickly had a product which gave results superior to the manure alone.

It is rather curious to note that although the Scotch landlord's advice was apparently forgotten, the same method is recommended to farmers by agricultural experts today. Hundreds of farmers have a supply of such fertilizer available but have made no use of it.

Indeed, a peat bog is often the most valuable part of a farmer's acreage, but it is a common sight to see land cultivated up to the edge of a swamp and the swamp itself neglected. In spite of the fact that our peat resources are almost untouched, the bogs are already producing most of our commercial crops of celery and onions and a large part of such crops as carrots, lettuce, cabbage, horseradish, peppermint and cranberries.

The methods used at a peat plant at Alphano, N. J., one of the largest in the country, illustrate modern methods of production. The bog here consists of about 1,500 acres and the deposit varies from two to twenty feet in depth. The land was a marsh until reclaimed by a drainage system.

The first step in the process is to till the land. Great crops of celery are raised here every year. The plowing and disking of the soil in farming it sun dries the surface and cultivation during the season kills off the weeds so that there will be no weed-seeds in the finished product, while lime is added to "sweeten" the soil. At the end of the season about three inches of the top soil, which is then dried to a moisture content of about 65 per cent, is scraped off and piled in great storage heaps near the plant.

The soil scraped off is then replaced by a specially designed machine which digs up peat with a chain bucket, shreds it, and then scatters it by means of a powerful blower. Thus after each crop the area of the bog is cut down a little by slicing away the sides to cover the top. This machine is shown on the cover of the present issue.

The peat goes through a general conditioning process in the storage piles and the bacteria are added to it here. When the peat is taken into the plant it is first passed through a set of spiral knives, operating like a lawn mower blade, which reduces the peat to a very fine granular form. The potash and other chemicals are added in a mixing machine and the peat goes through a final process of drying in huge mechanical dryers. Great care is taken not to overheat the mixture so that the bacteria are not injured.

This final drying has a double purpose. By reducing the moisture content a considerable saving in freight is effected in shipping the product in bags, and the peat is rendered more absorbent. Fertilizer is often applied with the grain drill along with the seed at the time of planting. A fertilizer for this purpose must be finely pulverized and must flow freely. The peat has the ability to absorb so much more moisture than the atmosphere can possibly give that it does not become soggy. Once the fertilizer is in the ground this absorbent quality causes it to act as a sponge in absorbing and holding water and it is a protection against drying out the land.

Part of the peat, which is sold to other manufacturers of fertilizer, is dried out very thoroughly before leaving the plant and it does not undergo the conditioning processes.

The growing popularity of peat fertilizer in the last few years has been largely due to the fact that many nitrates, which had hitherto been available for fertilizer, were used in making explosives for our army and navy. Most of the ammonia formerly used in fertilizer, the scarcest and most expensive of the ingredients, used to come from the tankage or waste of the great packing houses. But ammonia has advanced in price so that it is no longer profitable to use it for fertilizer.

Peat has its own natural supply of ammonia and because it is put there by nature it is distributed more perfectly than could be done by the best of mixing machines. Peat fertilizer has the advantage over chemical fertilizers that all of the chemicals are not immediately soluble. About one-third of them are at once available as plant food but the rest are released only through decay and the activity of the bacteria. The fertilizer hence remains effective for about five years after it is applied.

The new-born industry has been greatly aided by the American Peat Society, organized in 1907. The society now has some 300 members, with offices at 17 Battery Place, New York City. Its officers serve without pay. The society publishes a quarterly journal which includes original papers of practical experience, abstracts from contemporary literature and patents, and descriptions of the latest uses for peat, etc.

Although certain parts of Europe have used peat for fuel for many years, due to a lack of coal deposits, the annual consumption there now totaling about 10,000,000 tons, it is only recently that European peat manufacturers have recognized a common interest and have begun organization. The "Union des Tourbiers de France" has just been organized in Paris.

Because of this world-wide reawakening in the industry itself, as well as the widening scope of usefulness for the product and the great advancement in the science, we may expect to hear more and more of peat in the years ahead.

## Gas-Tubing Tests

(*Continued from page 499*)

(G) An all-metal end-piece screwed into the tubing; a very satisfactory connection where it is not necessary to connect and disconnect frequently. In attaching to an appliance care must be taken not to get the threads crossed.

(H) Tubing is glued into rubber end-piece directly. The strength of this type of attachment is usually small and leaks are very frequent with it.

(I) Metal tail-piece is screwed into end of tube and is held in rubber end-piece by corrugations which fit corresponding corrugations in the rubber. This is usually a satisfactory method of attachment.

## "Tennessee"—Our Latest Battleship

(*Continued from page 501*)

The "Tennessee" and "California" are the last ships that we shall build carrying the 14-inch gun. The next class, consisting of four vessels, the "Colorado," "Maryland," "Washington" and "West Virginia," will be about 1,000 tons larger than the "Tennessee"; but otherwise, so far as general appearance is concerned, will resemble her. The principal difference will be that eight 16-inch guns will take the place of twelve 14-inch guns, and that a great weight of protective armor will be employed.

## First Aid for Inventors

(*Continued from page 502*)

tions of the committee provide that it shall investigate "any subject referred to it by the institute or by any of its sections," or, by a majority vote of the members present at any stated meeting, it may investigate any subject presented on motion of a member or by application. The method of procedure for the unknown inventor to enlist the services of the committee is to write to Dr. R. B. Owens, Secretary of the Institute, stating what he has to offer and requesting an application blank. This is issued when the Secretary, through correspondence, is convinced that the appliance or process has merit.

The application blank contains the following questions which must be answered:

1. What is the specific purpose of this invention?
2. What is the condition of the prior art in this regard?

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3. What improvement is claimed to be effected by the invention?
4. How is the improvement effected?
5. What patents, if any, have been issued for this invention?
6. What citations, if any, were made in this regard by the Patent Office before allowance of patent claims?
7. Is the invention now in actual use?
8. If so, since when?
9. Where may it be seen in operation?
10. Are you prepared to submit drawings of the apparatus or device?
11. Are you prepared to submit a model of the apparatus or device?
12. If the invention is a composition of matter, are you prepared to submit specimens of the ingredients and of the compound sufficient for the purpose of experiments?
13. If the invention is a chemical process, are you prepared to give a demonstration of the same?

It is required also that the applicant submit two copies of each of the United States patents issued to him, with the answers to the above. He should send in also whatever additional information may be called for by the nature of the discovery.

The application is first referred to a sub-committee on new subjects and preliminary examination, which recommends to the general committee acceptance or rejection. This sub-committee and the general body hold formal meetings once a month, but this does not begin to indicate the vast amount of free time devoted to inventions. Regular meetings are held mainly for the purpose of coördinating the reports of investigation and experiment on the matters under consideration. When this sub-committee recommends an investigation a special subcommittee is appointed to conduct it. As a rule the sixty members of the general committee comprise experts in every line of mechanical and scientific work, but the institute has provided that wherever necessary the Science and Arts Committee may include in the investigating body "a minority of other persons whose expert services are desired in the examination."

There are other regulations for the protection not only of the institute, but of the applicant as well. One provides that "no person shall be a member of a subcommittee on investigation who is interested in the issue." Other regulations containing information that may be of value to inventors who may plan to make application to the institute are as follows:

"Sub-committees shall whenever possible make direct examination and tests of the subject under investigation, and shall not accept tests, data, or information furnished by others without first satisfying themselves as to the accuracy thereof. They shall in no case recommend an award solely on the basis of tests, data or other information furnished by parties in any way interested in the subject of the award. Sub-committee must ascertain that articles, processes, products, etc., examined are genuine samples of the subject under investigation."

The sub-committee may recommend award of the Cresson medal, the Howard N. Potts medal, the Edward Longstreth Medal of Merit, or the Certificate of Merit. These are awarded for the following reasons:

The Elliott Cresson Medal: For discovery or original research, adding to the sum of human knowledge, irrespective of commercial value; leading and practical utilizations of discovery; and invention, methods or products embodying substantial elements of leadership in their respective classes, or unusual skill or perfection in workmanship.

The Howard N. Potts Medal: For distinguished work in science or the arts; important developments of previous basic discoveries; inventions or products of superior excellence or utilizing important principles; and for papers of especial merit that have been presented to the institute and published in its journal.

Edward Longstreth Medal of Merit (with a money premium when the accumulated interest of the fund permits): For meritorious work in science or the arts, including papers relating to such subjects originally read before the institute, and papers presented to the institute and published in its journal.

Certificate of Merit: To persons adjudged worthy thereof for their inventions, discoveries or productions.

The Committee on New Subjects and Preliminary Examination for this year consists of seven members of the general committee and is typical of the wide variety of interests represented in the membership of the Franklin Institute. The chairman is Dr. H. J. M. Creighton, assistant professor of chmeistry at Swarthmore College. Other members are Charles E. Bonine, practicing electrical engineer; Nathan Hayward, president of the American Dredging Company and a consultant for the Bell Telephone Company; Lionel F. Levy, manufacturer of fine screens for half-tones; Charles W. Masland, manufacturer of carpets and textile expert; M. M. Price, chief engineer for the Babcock and Wilcox Company, and James S. Rogers, an attorney.

There is hardly a member of the general committee whose record does not require considerable space in "Who's Who," and all are known in scientific or technical lines. One man, Hugo Bilgram, has been a member of this committee continuously since 1873. His hobby is mathematics, and he is nationally known as a manufacturer of gear teeth and precision machinery. A few others of note are Dr. James Barnes, professor of physics at Bryn Mawr College; W. C. L. Eglin, vice-president and chief engineer of the Philadelphia Electric Company; Dr. A. W. Goodspeed, professor of physics at the University of Pennsylvania, and Dr. Gaetano Lanza, emeritus professor of mechanical engineering at the Massachusetts Institute of Technology and now consultant to the Baldwin Locomotive Works.

Direct service is given by the institute to young men of a mechanical or scientific turn of mind through its classes in mechanical drawing, architectural drawing and design, freehand drawing and water color, shop arithmetic and algebra, plane geometry and trigonometry, applied mechanics and machine design, and theoretical and practical naval architecture.

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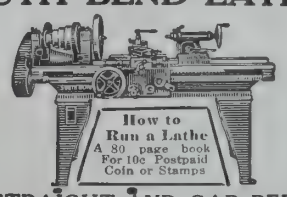


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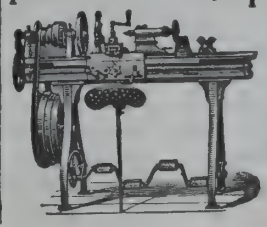

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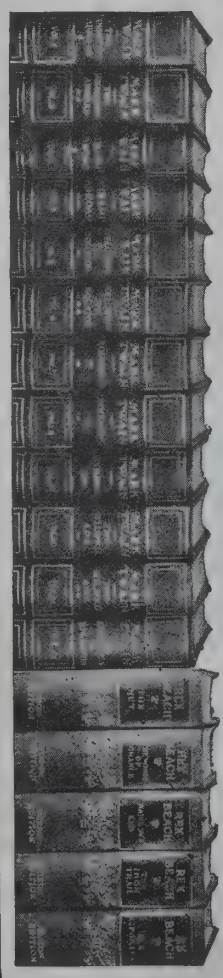

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(14352) L. M. A. asks how to separate gold and platinum. A. Usually where there is gold and platinum there is also silver in the alloy. To separate them, be they in filings or pieces, reduce them like gold with aqua regia, in a porcelain dish; cover with a glass funnel; set in a chimney or where the fumes can escape on hot sand, until the metal is all dissolved. Let it remain in the warm sand bath until the liquid has evaporated to the consistency of syrup, and then let cool. Pour on enough muriatic acid to well cover the syrupy mass, cover again with the funnel, and let evaporate on the sand bath again till a syrupy mass results. To every gram of metal five grams of water are added to the mass, well mixed and boiled for half an hour. Let it get cold, then filter through a close filter paper and a glass funnel, and the particles remaining in the filter paper are silver. The silver on the filter paper can be melted in the usual way. The above filtered solution is now treated for platinum. In a pint of boiling water put 200 grams of powdered sal ammoniac and let dissolve; then mix this with above solution, stirring well with a glass rod. Let stand for two or three hours to settle. The platinum gathers in an orange-like mass at the bottom which is the chloride. Filter off the top carefully without disturbing the yellow very much. The yellow mass is mixed with about 300 grams of water, well stirred. Keep on stirring and filter through the already used filter. Let drip out well and the precipitate on the filter is platinum. Let this dry for 24 hours, place in a crucible, pressing the filter paper in well so it will serve as a cover. Heat gradually until no more smoke rises and a white-red heat is obtained. Let cool, then melt again and run into an ingot or button.

(14353) R. F. N. asks how to clean tarnished gold after hard soldering. A. Before attempting to solder gold, paint over with a paste made by mixing yellow ochre ground up with water and a small quantity of borax. This paint will somewhat protect the surface from oxidation. After soldering, the gold should be placed in a pickle composed of nine parts water and sulphuric acid 1½ parts. It is best to throw the gold in the pickle while still hot from the soldering. Very often the soldered and pickled gold will show whitish in streaks, caused by the silver in the alloy. If so, dip for moment in a hot pickle solution of sulphuric acid and saltpeter, then dip in cold water, wash clean and proceed to polish, first with rotten stone and oil. Wash again and finish polishing with rouge.

(14354) H. W. J. asks: I am a constant reader of your magazine and would greatly appreciate information through your columns concerning the behavior of lines of magnetic force, preferably lines around a permanent magnet. The specific information is to know if it is possible to "insulate" to any extent a permanent magnet so that the lines of force will not attract steel or iron. In other words is there any substance, solid, liquid or gas which can be placed between a magnet and its armature or attracted object so that that attraction is no longer felt by the object or witnessed by an observer? If there is no such substance, why not? or is it an impossible thing and oblige. A. Lines of magnetic force cannot be confined in a space as the electric current can be by insulation. The only way in which they can be prevented from entering a space is by furnishing them with an easier path around that space. Iron furnishes such a path, since its permeability is greater than air or any other substance. A magnet is protected, insulated, if placed in a box of rather thick iron, perhaps a half inch plate.

(14355) R. M. S. asks: Please be so kind as to give us information in regard to light and heat from the sun direct. It is taught in our schools that we receive light and heat directly from the sun, as we do from a bonfire, as we stand near it at night. On the other hand some scientists say not so. That in all those 95 millions of miles it is intensely cold and dark and therefore impossible for light or heat to pass through. So in our schools and colleges are they teaching a lie? If you will kindly answer this it will be greatly appreciated by a number of us inquisitive ones who wish to know. A. The rays of the sun as they pass through space are neither haet nor light. They are capable of becoming heat if they strike anything which can be heated, your hand, for instance, or they will become light if they strike an eye which can transform them into light. The heat from a bonfire heats the air because the air can receive it, but it will not heat a vacuum where there is no air. Space, empty space, we often call it, but it is not quite correct to call it empty, is not heated by the rays of the sun. The air itself at high altitudes is not heated very much by the sun's rays as they come down through it as is seen by those who find it extremely cold upon going up in airplanes or balloons. The powerful rays of the sun lose very little of their energy in passing through space because there is very little there to intercept them. They lose some more in our upper air but still have great power left which they give the earth at its surface, enough to produce the growth and life which we see.

(14356) R. L. W. asks how to refine commercial gold. A. If one desires to obtain pure gold from gold of inferior qualities the scraps should be treated in the following manner: To one ounce of mixed qualities of gold add two ounces of fine silver. Place the material in a plumbago crucible and melt in a good furnace, a little powdered charcoal being added to protect the fusing mass from the action of the air, which would otherwise cause a scum to appear on the surface. When the mixture is thoroughly melted it must be formed into a deep vessel of cold water kept well stirred in a circular direction during the operation; this will cause the fused alloy to break up into small fragments; or the fused alloy may be poured into a hot ingot mold and afterward rolled down into thin sheet metal and cut up into pieces sufficiently small to enter the mouth of the dissolving flask. The object in doing this is to present as large a surface as possible to the action of the acid which is employed to dissolve the metal. The small particles of metal are carefully collected together and placed in a glass dissolving flask, and to each ounce of the alloy two ounces of pure nitric acid and two ounces of water are added. The flask is then placed on a sand-bath and gentle heat applied until all the metals—with the exception of the gold—are dissolved into the liquid; the gold remains undissolved at the bottom of the flask, in a finely divided form of pure metallic gold. It will thus be seen that the acid mixture dissolves the silver and copper but not the gold. The brown powder of metallic gold is then washed well with either hot or cold water and the washing added to the first solution which was poured away from the gold in the flask. The gold is next dried and melted in a clay crucible under a small quantity of dried common salt, and should then be quite free from base alloy. If the gold is required for making a gilding solution, it may be taken in the powdery state, direct from the washing operation, and dissolved in aqua regia, and subsequently converted into chloride of gold. It may be advisable to obtain absolutely pure gold to add a little fresh acid to the gold powder before removing it from the flask, to make sure that all the silver and copper have been removed. Heat must be applied as before to cause full chemical action. The silver and copper will be in the fluid poured from the dissolving flask in the form of nitrate of silver and nitrate of copper, and should be preserved with the view of recovering the silver.

(14357) C. F. D. asks: As farm lighting plants generally are of 32 volt potential am I right in concluding that that is as high as permissible? What is the highest voltage direct current that is considered safe for children and other people to handle? A. Farm lighting plants are generally run so that the dynamo is not run all the time, but charges a storage battery and this supplies the lamps in the evening when it is not convenient to run the dynamo, if run by water, or impossible to run it, when it is calm, if run by a windmill. The cost of a storage battery is so large that the voltage of the lamps and other machines is kept as low as can be, so that the number of cells in the battery may be as small as can be. The usual voltage of an incandescent lighting circuit is 115, and this is quite safe. It might be that a peculiarly susceptible person would be injured by a shock from it, but ordinary people only feel it as a needle or pin prick. 300 to 500 is the limit of low voltages. Above 500 the shock is severe.

IN THIS ISSUE:

OUR COAL IN THE MAKING
TAMING THE RIVER NILE

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

USING THE VERTICAL CAMERA TO PHOTOGRAPH AUTOMOBILE PARTS.—[See page 527]

Vol. CXXIII. No. 21
November 20, 1920

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Price 15 Cents
20 cents in Canada

Entered as second class matter June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879

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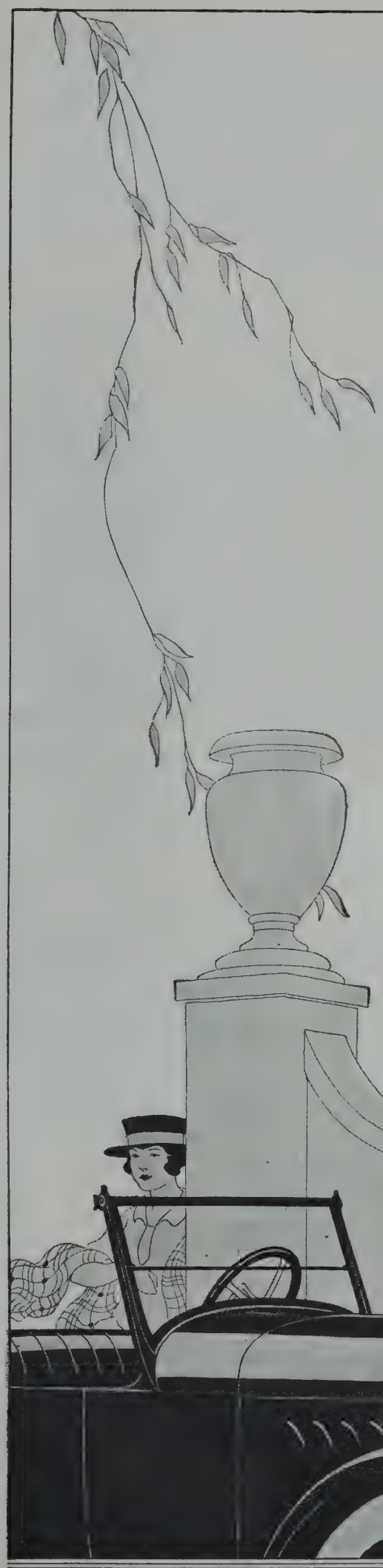

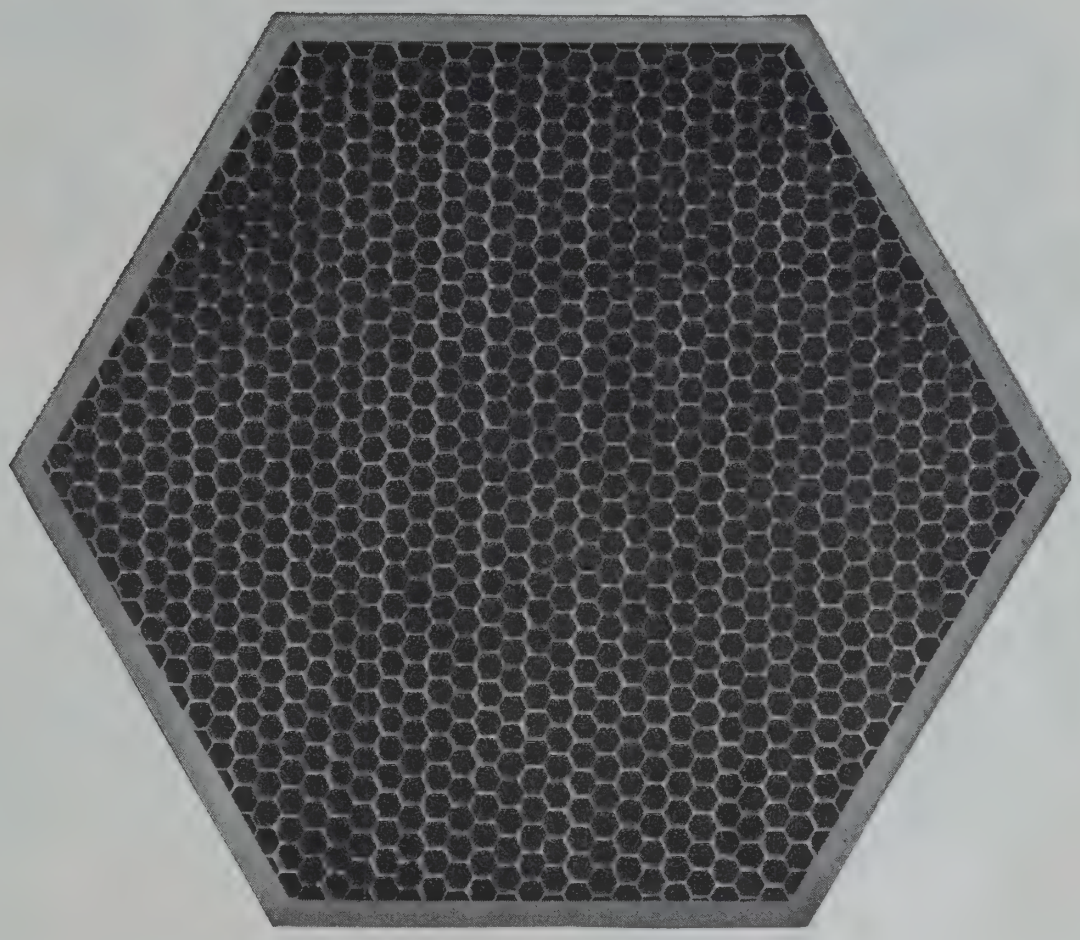

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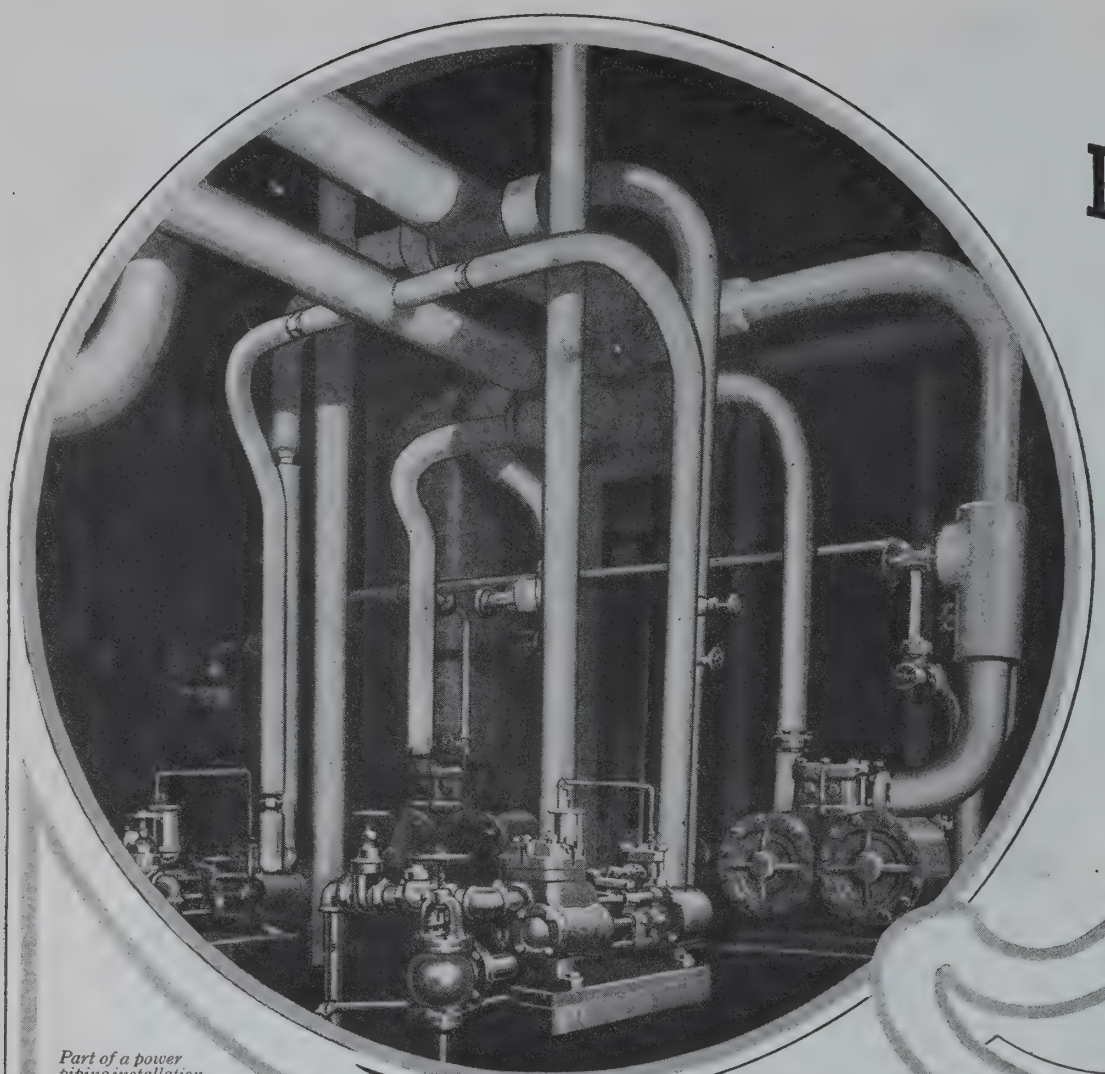
# INDUSTRIAL PIPING EQUIPMENTS



*Part of a power piping installation at the Rhode Island Co., Providence, R. I.*

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## Are Shut-downs Inevitable?

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Inevitable? Not if we accept the judgment of consulting Engineers and experienced plant Superintendents. They tell you almost to a man that this waste is due to poor design, faulty materials, or poor installation. It has been said on the best of authority that sixty per cent. of the steam power plants in New England could be modernized at a profit to owners—a handsome profit on investment. Generally the inefficient equipments are the older ones and the fault is due to the fewness of *experienced* organizations that were doing such work 20 or more years ago.

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SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 21

NEW YORK, NOVEMBER 20, 1920

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1. The train and its passengers. There are usually five cars and the passengers are divided evenly on either side. 2. The bizarre monorail locomotive of the railroad. 3. A road crossing, using a lift bridge to cross the railroad track. 4. A farmer using the monorail track as a gate to his front yard. Between train times the gate is left open for the farmer's convenience.

**Ireland's monorail steam road which is decidedly out of the ordinary**

Copyright, E. M. Newman

## A Curious Little Monorail Road in Ireland

THE odd little locomotive, cars, and track, of which we show several views, are to be found in a picturesque part of Ireland beloved by the tourist, for it runs from Killarney to Bally Bunion. In spite of its novelty, at least to American eyes, it is by no means new, for it has been serving the district through which it runs for lo, these many years.

During the closing years of the nineteenth and the opening of the twentieth centuries, railroads running on a single track had quite a vogue, particularly among people of an inventive turn of mind. Steel rails cost money, and so do the broad track and expensive ties on which the rail is laid. How natural, then, to seek an escape from the high cost of railroad construction by cutting the width of the tracks in half, throwing out one rail altogether, and reducing the number of wheels beneath the locomotives and cars by one-half.

The attempt to build a satisfactory monorail system produced a great variety of designs, many of which were illustrated from time to time in the SCIENTIFIC AMERICAN. There was the overhead monorail, as used in Germany, in which the cars are suspended by means of what is actually a massive hook from a pair of little trolleys which engaged the single overhead carrying rail. Another system which was tried out on a short length of trolley line running to City Island, New York, had a single track laid upon the roadbed with a steadying overhead rail, carried on standards at the side of the track, which was placed above the cars and was engaged by a pair of small wheels carried in a stout rigid rig extending from the roof of the car.

The Bally Bunion monorail system is practicable, but we believe has never been extended beyond its present length and has never shown any advantages over the standard system of railroad track construction which would warrant the system being brought into extensive use. The carrying rail is mounted at the apex of a series of A-frames which are bolted down to short wooden ties. At about one-third of the height of the A-frame is mounted a pair of steadying rails which engage rollers on the cars and serve to keep the rolling stock in a vertical position.

The latter is built in two sections; and this is carried so far that steam is generated in two diminutive little boilers which are mounted one on each side of the track. The cars also are built in two halves, and, like the locomotives, they are carried by plate-steel frames in which the main carrying wheels for transferring the load to the track are mounted. The cars are of the well-known British and continental pattern, with separate compartments and a side door to each compartment. Very curious is the simplicity of the track arrangements of this railroad. Take note of the road crossing, in which the roadbed consists of two hinged, counter-weighted leaves, which are raised and lowered by means of chain and pulley on each side of the track. A decided curiosity is our picture of an Irish cottage, where the gate to the yard consists of a section of the track which is so mounted on a vertical standard at one end, that it can be swung open for a wagon and shut for a train.

## Living Bean Poles

AS the nation's lumber supply has dwindled and market prices for wood risen markedly, substitutes for wood have been originated. The paper boxes now in such extensive use as shipping packages are some such. The garden is a queer place to look for substitutes for wood, but you can find them there.

A gardener in an eastern State remarked the other day that he believed bean-poles would cease to be common sights in city backyard gardens because of their cost and the difficulty of obtaining them. He said that a substitute for them had been found—the Giant Russian sunflower. Many small gardeners last season used sunflowers for poles. They planted two or three seeds with each hill of climbing beans, and thinned to leave one sunflower plant to each hill.

Up this live "pole" the beans twined and ascended. The gardener kept all leaves off the sunflower except several at the very top. They made excellent poles, yielded a crop of their own, and were cheap. Low cost, and the convenience with which they are provided, are big advantages of the sunflower bean-pole.

Of course, the sunflower isn't the first make-shift bean-pole. Throughout those farming regions of America where wood is scarce, climbing beans for decades have been planted almost wholly in the corn. There are Western farmers who don't know what you mean when you speak of "pole" beans. They call them "cornstalk" beans, because of the universal use of the makeshift pole. A cornfield is not an ideal place for beans, however, because of the degree of shade.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Problem of the "Leviathan"

WITH the three largest transatlantic liners in the world for sale and no bidders, the question presents itself as to whether dimensions, speed and luxurious appointments have not been pushed too far, even to the point of *reductio ad absurdum.*

The public is more or less familiar with the case of the "Leviathan," formerly the "Vaterland" of the Hamburg-American Line, which made her maiden trip to this port a few weeks before the war, and with the exception of a term of service as a transport, has been tied up continuously at her dock at Hoboken for the past six years. Subsequent to the armistice, the Government offered this magnificent liner for sale, and a bid of $3,000,000 was put in with a proviso that the Government should make a loan, at a low rate of interest, of $6,000,000 to enable the company to put her in condition. The bid was rejected and the ship still lies at her pier with a caretaking crew aboard, who with grease, oil can and paint pot, are doing their best to prevent deterioration.

The original cost of this 54,000-ton ship, although she was built at pre-war prices under the economical system of a first-class German yard, must have been from $8,000,000 to $10,000,000. To reproduce the ship today would cost twice that sum, and the cost might well run up to $25,000,000. True it is that the cost of reconditioning the ship and turning her into an oil burner would be heavy. On the other hand passenger rates on a ship of her class are proportionately high, if not higher, and once in service she should attract the cream of American travel to herself—provided the cuisine and general service were begun and maintained at the high level reached by her competitors. Failing that she would be an unutterable failure.

We are rather inclined to think that the reluctance among our shipping men to take charge of the "Leviathan," either by outright purchase or by charter, is due in some measure to a conscious lack of experience in what might aptly be called the floating hotel business. On the technical side they have no anxiety whatever, for our engineer force got greater speed out of the "Leviathan" when she was in transport service than she had ever shown in German hands, and as navigators our merchant officers are second to none. But when it comes to receiving some three thousand people aboard ship, and feeding and housing them with the delicacies and comforts of public hotel or private home, the problem assumes stupendous proportions and calls for long experience and very expert skill. It is one thing to run a 5,000-ton passenger ship to the West Indies but quite another thing to run a 54,000-ton "Leviathan" to Europe.

Another of the big ships that is on the list for sale is the "Bismarck," sister to the "Leviathan" and built at the same yard on the same building ways. Work was carried on in a desultory way upon her during the war, and Germany has undertaken to complete the ship and place her at the disposal of the Allies. Structurally she is complete, we believe, the unfinished work consisting of the fitting and furnishing of the passenger accommodations. The Germans are urging that she be broken up and the material be used in the construction of ships of a more usable size. So far as ownership is concerned, she has passed out of their hands, but the suggestion shows that her builders are disposed to look upon this huge passenger ship as something of a white elephant. This much is certain, that among the many rumors regarding the "Bismarck" there has never been so much as a hint of a prospective purchaser.

The third ship, "Imperator" of 52,000 tons, was apportioned to Great Britain as part of the compensation for the destruction of 9,000,000 tons of her shipping during the war. She is being operated by the Cunard Company pending her sale; but apparently no satisfactory bids have been received, for she is still Government property and is likely to remain so for some months to come.

## Why Not the Torpedo Motor Boat Carrier?

IN the contest last summer for the Harmsworth Cup the race was won by a little 26-foot motor boat which is credited with an official speed of 70 miles an hour. It detracts nothing from the credit of the victory to say that "Miss America" consisted of a pair of Liberty engines with a boat built around them. She showed what the gasoline motor was capable of doing under extreme conditions of maximum power of engine and minimum size and weight of boat.

To the serious naval constructor, who at no time in the progress of his art has been hedged about with so many and so difficult problems as today, the mere fact that any kind of a sea craft has made 70 miles an hour should be a matter of great significance. He knows full well that, starting with a basis of two Liberty motors, or 800 horse-power, which is what "Miss America" carried, it would be possible to build a torpedo-carrying motor boat whose offensive power could be increased in proportion as speed was sacrificed. To put it more concretely, he could make a guess offhand that a modified motor boat of the "Miss America" type, larger, stronger and more seaworthy, could be built that would carry a 21-inch torpedo at a speed of 40 knots. "Miss America" was built for fair weather and smooth water, and it is well understood that the phenomenal speed of these little craft falls in proportion as the seas run high. Nevertheless it is quite possible, by increasing the size and modifying the model, to produce high-speed craft which will hold their speed under conditions in which the out-and-out hydroplane of the "Miss America" type would be helpless.

Rear-Admiral Taylor, Chief Constructor, in his recent masterly summing up of the naval lessons of the war before the Franklin Institute, commented favorably upon the work done by Allied motor torpedo boats during the war. "The little boats," he said, "performed splendid service off the Belgian coast," referring, no doubt, to the British 40-knotters, which, on their very first cruise sank a German destroyer. He stated also that "the most spectacular and at the same time most valuable service performed by boats of this type was the daring penetration by the Italians into a fortified Austrian harbor, where they sank a battleship lying at anchor. Later, in operations against the Bolshevists, a small British flotilla penetrated to the inner harbor of Kronstadt, where they succeeded in sinking two battleships and two other large vessels."

These performances seem the more remarkable when we remember that they were accomplished by experimental vessels, the first of their type to be built. Subsequent improvements, as worked out in this country, are in the direction of greater size and seaworthiness, coupled with a wider range of action, better accommodations for the crew, and ability to carry the largest torpedoes.

The point is made by the naval constructor that the objection to such craft is that they are too small to keep the sea with the main fleet. It is undeniable, on the other hand that, were it possible to take two or three flotillas of 40-knot, torpedo-carrying motor craft into such an action as that at Jutland, they would inevitably exercise a controlling influence on the tactics of the battle, and might well prove to be its deciding factor; for we must remember that there was a calm sea at Jutland throughout the whole of the day and night engagements.

But how are motor boat flotillas to reach the scene of a battleship engagement on the high seas? They have neither the cruising radius nor the sea-going qualities to enable them to cruise with the fleet. So, if they are to get to Jutland, they must be carried there. In this respect the problem is parallel to that of the airplane which, it was known, would be a formidable weapon could it be present in numbers at a naval engagement. In the case of the airplane the problem was met by designing special airplane carriers, and in the case of the torpedo motor boat it can be solved in the same way by providing motor boat carriers. These would be unarmored cruisers about 800 feet in length and of 35-knot speed, specially built for carrying forty boats on two decks. The boats would be stowed, two abreast, throughout the full length of the ship, and electrically operated davits would be provided with gears sufficiently powerful to put the first flotilla of twenty boats in the water within a few minutes' time and a second flotilla of the same size shortly thereafter.

It is a question worthy at least of consideration, whether four such ships, taking position on the four wings of an enemy's line of battle would not constitute a more deadly threat than four battle-cruisers of the same size and speed. We do not say that they would, but we do claim that the question is worthy of the most careful consideration of our naval constructors, of our War College and of the General Board of the Navy.

## Invention or Discovery

A. H. WALKER, in his standard work on Patent Law, draws a definite line of demarcation between invention and discovery. "The statute provides that patents may be granted for four classes of things. These are arts, machines, manufactures, and compositions of matter. None of these things can be originally made known by discovery, as our continent was. They are not found but created. . . . Laws of nature, on the other hand, can never be invented by man, though they may be discovered by him."

For practical purposes of patent and copyright law this distinction may be well enough. But if we love argument, we may enunciate the proposition that invention is the discovery of a fact or facts in the realm of the mind, just as geographical exploration, for example, may lead to discoveries in the realm of objective things. This may seem far-fetched, but the proposition finds support in the words of no less an authority than Emerson. For, "Poetry was all written before time was." This is not the place to quote the great essayist at length. Those who wish to refresh their memories may do so by consulting the original. Suffice it to say, that Emerson looks upon the poet, not so much as a creator, an inventor, but rather as the interpreter, the discoverer of that which existed from all time; the man whose ear is delicately attuned to the music of the spheres; whose eye is keen to discern the great truths, "which others, knowing not, pass blindly by."

We may subscribe, broadly, to Emerson's point of view, and look upon invention as the discovery that a thing can be done in a certain way, a thought expressed in certain words; and this without endorsing the insane scheme of a certain madman, of whom we read years ago, who proposed to discover all truth by writing out all words of our language in every possible combination. Some of these combinations, he said, will form sentences revealing great and new truths, and by continuing long enough we shall eventually know all truth. The reader who is mathematically inclined may amuse himself by figuring out what the probabilities are of hitting on a new truth by this method within a week, a year or a century. We recall, too, from our school days, a mechanical device, a sort of multiplication table, for composing Latin verse without mental effort. Making all allowance for the use of Roget's Thesaurus, of rhyming dictionaries and other mechanical aids to composition, it is not, of course, by any such devices as this that the great writer, or even the lesser author, makes his "discoveries." But we may liken the writer's mind to a kaleidoscope; under the stress of intense feeling (which underlies all the best in literature), the right words come to mind spontaneously, and array themselves in rhythmic cadence, as if reflected into a well ordered pattern by the facets of his mind, like the many colored prisms in the kaleidoscope, tumbling in fortuitous disorder, yet ever complementing each other, through the mirror, into a pretty geometrical design.

## Electricity

**An Electrically Welded Ship.**—From the London *Engineering* we learn that the "Fullagar" is an entirely welded ship. The success of this ship has shown that welding is effective for all purposes in such work. It is not claimed that it is necessarily the cheapest method. The ship is one of 25,000 cu. ft. displacement.

**Radio Equipment of the "Vaterland."**—On this ship recently recommissioned, there are three complete wireless transmitters, one of which is worked in connection with a high-frequency generator, this being the first instance of the use of such a generator on board ship, according to *Wireless World*. For transmitting on waves of 600 to 1,800 meters, and for use with the high-frequency generator, an aerial 190 meters long is carried. For shorter wave lengths and for emergency transmitting two other aerials are provided, each consisting of a single wire spread between the funnels.

**For Testing Dry Batteries.**—The Bureau of Standards, Washington, D. C., has issued technologic paper No. 171, entitled "Automatic Apparatus for Intermittent Testing," which describes equipment devised to meet the needs of the bureau in making tests of dry cells and storage batteries, but is applicable to nearly any form of intermittent testing requiring the closing of electrical circuits at regular time intervals. The particular advantages of this type of apparatus for making these tests are: Elimination of rapidly moving parts, accuracy of the time intervals, and possibility of making a number of different tests simultaneously with the same apparatus.

**The Printing Telegraph** is being employed more and more for press news service. In fact, the American Telephone & Telegraph Company expects to change the press news service over to printing telegraph machines as fast as it is practicable to do so. For several years the company has used the printers for a portion of this service in New York, Boston and Chicago, and much of the company's inter-office communication between New York and Chicago is carried on by this means. The printing telegraph has now been developed so that, depending on the class of service, a transmitting speed of twenty to sixty words per minute can be obtained, and by means of synchronized machines sixteen messages, or eight in each direction, have been sent over one wire.

**A Self-Exciting Mercury-Arc Rectifier.**—A difficulty with ordinary mercury-arc rectifiers is their tendency to go out if the load drops below a certain point. There has recently appeared in Germany a new kind of "self-exciting" rectifier, which will keep going even if the load is completely shut off. The new rectifier type is of glass, quite similar to current models, but is provided with two auxiliary anodes fed from a special winding on the input compensator, according to *Elektrotechnische Zeitschrift*. The winding has a midpoint tap which is connected to the cathode, and in the auxiliary-anode connections are inserted two resisters, so that the auxiliary system forms, as it were, a small rectifier within the power rectifier. This auxiliary rectifier system takes about 100 watts, is started in the ordinary way and is always kept running. It will then automatically excite the power arcs so that the main rectifier starts as soon as the direct-current output circuit is closed, and the rectified current thus is perfectly stable down to very small current strength.

**Something New in Arc Lamps.**—About two years ago we had something to say regarding a novel form of enclosed arc employing tungsten electrodes and enclosed in a high vacuum, developed in England. At that time the inference was that the lamp was of a purely experimental nature, but we learn of late that this arc lamp is a commercial success. Briefly, the lamp resembles a round incandescent lamp so far as exterior design is concerned. Instead of the usual filament, however, the lamp contains a small ball of tungsten, a horizontal tungsten rod, and a small tungsten coil right over the tungsten ball. To start the arc the vacuum must first be bridged, since the electrodes are fixed. This is accomplished by passing a current through the tungsten filament which becomes incandescent and heats the surrounding vacuum. Then the current is switched over to the gap between the horizontal tungsten rod and the tungsten ball. The heated vacuum, no longer being an insulator, carries over the 110-volt current and the tungsten ball is heated to incandescence by the arc. The result is an extremely concentrated source of high candle power, suitable for numerous purposes. At present M. Belin, the inventor of the system for transmitting photographs over telegraph and telephone lines, is using such a lamp for the source of light in his receiving set. The details of M. Belin's apparatus appeared in our November 6th issue.

## Science

**Medical Congress in Batavia.**—The Fourth Congress of the Far Eastern Association of Tropical Medicine will be held at Batavia, Java, in August, 1921, under the patronage of the governor general of the Dutch East Indies. The third congress was held at Saigon, Indo-China, in 1913.

**Februaries with no Full Moon.**—An English writer, Mr. S. H. Gaythorpe, has computed the number of years in the 19th to 24th centuries, inclusive, in which the moon does not become full in February. During the 19th century this occurred in 1809, 1847, 1866 and 1885. In the present century there are only two cases; viz., 1915 and 1961. In the next four centuries there will be 14 cases. "By a singular coincidence," he writes, "this happens to be of the same degree of frequency as the occurrence of five Sundays in February, though the two events are quite unrelated, the latter happening regularly thirteen times in four centuries."

**Hay-fever Resorts.**—In Public Health Reports for September 24, 1920, Dr. William Scheppegrell publishes statistics showing the beginning and ending of the spring and autumn hay-fever seasons in each State of the Union; the plants chiefly responsible, in each State; and a list of "hay-fever resorts" for all States where such places are known. These resorts are places that are free from hay-fever pollens, and where the hay-fever patient can find relief from the disease. As the pollen of most hay-fever plants is very buoyant and will traverse 5 or 6 miles when the winds are favorable very few places in the country are absolutely free from this troublesome disease.

**A Remarkable Case of Overpopulation** is that of the Island of Bukara, in Lake Victoria Nyanza, described by H. L. Duke in the *Cornhill Magazine*. This island, with an area of 36 square miles, much of which is bare granite, though isolated from the rest of the world, supports a population of 19,000. The small garden plots are carefully marked off and rights of ownership are rigidly observed. Trees are valued more than the land on which they grow. In some cases one man owns the trees and another the ground. A man must not steal his neighbor's leaves, sticks and rubbish. A father may even divide a tree among his children, allotting certain branches to each.

**Guatemalan Reconstruction.**—A very definite program has been prepared in Guatemala City for the reconstruction of the public buildings destroyed in the earthquake of December and January, 1918-19. Present plans call for a large amount of armored concrete construction material, of approximately 20,000 barrels of cement, with a proportionate amount of structural iron for reinforcing, and of tongue and groove lumber for flooring. In addition to the plans for the housing of the Government offices the construction of roads and highways is contemplated; also the reconstruction and increase of the water supply of the city. It is reported that an electric tramway system is contemplated, with an interurban line to Antigua, some 25 miles distant.

**The American Meteorological Society,** organized in December, 1919, has already attained a membership of nearly 1,000, a good evidence of the interest now taken in the study of the weather and the atmosphere by people in various walks of life throughout the country. Professional meteorologists constitute a small minority of the membership, which includes representatives of all professions concerned in any way with atmospheric phenomena, such as aeronauts, mariners, hydrologists, engineers, medical men, etc., besides the general public. A branch of the society is being organized in Brazil by the director of the Brazilian meteorological service, and a Pacific division will probably be organized next summer. The society publishes a monthly *Bulletin*, received by all members, who pay a membership fee of one dollar per annum. The secretary of the society is Dr. C. F. Brooks, U. S. Weather Bureau, Washington, D. C.

**Remedies for Poison Ivy.**—The *American Botanist* records that Mr. W. L. McAtee of the U. S. Department of Agriculture has collected a list of 244 alleged cures for "ivy" poisoning. Among the vegetable substances recommended to be taken internally are extracts or infusions of sweet fern, snakeroot, pasque flower, aconite, spice bush, coffee, poison sumach (!), pipsissewa, yellow jasmine, belladonna, and bryony. It is pointed out that "poison ivy probably has a reputation for harmfulness all out of proportion to its abilities; a few people are rather severely poisoned by it, but the majority seem to be immune or nearly so." We should like to add that a great deal of supposed "ivy" poisoning may be due to other plants, since there are scores of plants that are capable of causing more or less severe dermatitis in susceptible people. Copious information on this subject was published in 1887 by Dr. J. C. White in his book "Dermatitis Venenata."

## Automobile

**Cost of Trucking.**—An Akron manufacturer running his own motor trucks between that city and Cleveland has analyzed the cost and time features of three competing methods of transportation. Motor trucks cost 36½ cents a hundred pounds, railroad freight, 80 7/10 cents a hundred; railroad express, $1.044 a hundred; and electric trolley express, 87 4/10 cents a hundred. Motor trucks costs include all direct and indirect charges. The average time for motor truck delivery is 4 hours and 9 minutes—for the other three methods, 12 to 48 hours.

**Sliding Gearset Trouble.**—In some transmissions of the sliding gear type the high speed or direct drive is obtained by the sliding gear, which provides the intermediate speed having a suitable extension from its face designed to mesh with an internal gear, and thus form a positive driving clutch to couple the gearset main shaft portions together. When the teeth on the male clutch member become worn considerable trouble will be experienced in securing positive engagement, and if the wear is such that the width of the teeth is materially reduced a new member will be needed. If the teeth are not worn, but are only turned over at the edges, they may be dressed to proper contour by using a very small, high speed emery wheel on the end of a flexible shaft or by removing the offending member and grinding it in any suitable machine.

**Commercial Motor Truck Exports Reflect Healthy Market Condition.**—Exports of commercial motor trucks from the United States for the months of October, November and December of 1919, and for January and February, 1920, are represented by the following figures taken from the reports of the Bureau of Foreign and Domestic Commerce:

| Month | No. | Value |
|---|---|---|
| October | 1,301 | 2,931,204 |
| November | 1,712 | 3,143,351 |
| December | 1,465 | 2,495,685 |
| January | 1,721 | 2,727,856 |
| February | 2,889 | 4,130,468 |

By far the greater number of motor trucks went to France, England and Canada, the remainder of the exportation being divided between over one hundred other countries. It is expected that later reports will indicate a similar ratio of increase.

**Tractors Popular in France.**—French agricultural experts and M. Thoumyre, under Secretary of State for Agriculture, announce the prospects for the wheat crop in France this autumn are excellent, according to the *London Mail*. More land has been put under cultivation and with the use of fertilizer and motor traction it is hoped that French soil will this harvest suffice to produce nearly all the corn needed for next year's consumption of bread. According to the official figures of the French Department of Agriculture this year five million hectares or over 12,350,000 acres of land have been plowed and sown with wheat. This should produce at least seventy million quintals of wheat, leaving about ten million to be imported. Last year the home crop was so small that more than thirty-five million quintals had to be imported. This bumper wheat crop is expected to save France the huge sum of six and one-quarter milliards of francs (one and one-quarter billion) and thus cause a considerable improvement in the value of the franc.

**Have Steam Cars a Future?**—Among pioneer motorists there have always been numbered a few enthusiastic supporters of the steam car. Despite the gradual disappearance of the steam car, that interest still exists, and it needs but the slightest encouragement to make itself manifest. Although the internal-combustion-engined passenger car seems to have ousted its rival—for only in the United States is the steam car still manufactured—yet recent developments in steam engineering, such as the oil-fired steamships and locomotive engines, suggest that were the steam car reintroduced on modern lines it would prove vastly superior in efficiency to its predecessors. At the present time the rising price of gasoline is focusing attention on alternative fuels, and it must be remembered that the steam car presents another method of utilizing kerosene and even crude oil as fuel. If we concede that a heavier grade of oil fuel than kerosene even, might be utilized in the light of experience gained from oil-fired furnaces, then it is conceivable that the steam car might be in a better position than formerly to compete against cars engined with internal combustion motors. This is, however, rather in the nature of conjecture, and we do not wish to raise false hopes in the breasts of the steam car enthusiasts as only one company is producing these cars on a really commercial scale. Others have been formed but the production has been limited to a few experimental models.

# Something Different in Salvaging Operations

## Relieving a Wreck of Its Cargo with the Aid of Injections of Compressed Air

By Robert G. Skerrett

IT is the unique thing in salvage procedure that makes it plain that the more or less deeply sunken craft is no longer a wreck to be classed off-hand as a total loss. Similarly, these occasional evidences of engineering resourcefulness show what the scientific mind is doing in the way of revolutionizing this department of human effort. And what is equally significant is that the skillful application of the force and buoyancy exerted by compressed air is making these advances possible. Probably no example of this is more instructive than the work recently done in raising and freeing the freighter, "Canadian Recruit," from a very difficult position.

The ship, a steamer belonging to the Canadian Government, sailed from Quebec in the latter part of December a year ago, and on her way seaward had to contend with heavy ice. As a consequence of her struggle to get clear she lost her rudder and was driven ashore. In the months that followed, the floes, impelled by the tides, shifted the vessel, and at the same time cut away the river bed under her stern, causing the ship to settle deeper there. She finally came to rest with her after deck 29 feet below the surface at low water and listed over to port at an angle of 18 degrees.

The run of wreckers along the St. Lawrence looked upon her recovery as exceedingly doubtful, but one concern having affiliations with United States experts essayed her refloating on a "no-cure, no-pay" basis. To make the problem harder, it should be pointed out that the steamer was stranded forward in shoal water, and she carried a general cargo which substantially filled her several holds. The "Canadian Recruit" is 250 feet long, has a beam of 43.5 feet, and a depth of 26 feet—a sizable craft.

The ship was hard and fast on Mille Vaches Shoals, where the tides run very strong and have a rise and fall of many feet; and to add to the difficulties the steamer lay in an exposed position with comparatively little water around her forward end for the prosecution of wrecking operations. Her release was primarily contingent upon the removal of much of her freight; and the nature of her cargo was such that it was well worth reclamation. Not only that, but because the stuff stowed aft was made up in part of many cases of glass bottles, ordinary dredging facilities could not be employed to clear the submerged hold. That is to say, had clam-shell buckets been used the bottles would have been smashed, and broken glass would have imperilled the divers at every step. Besides the boxes of bottles, the after cargo space held several hundred bales of hay, some tons of cement, more than 2,000 pieces of heavy lumber, and quite 8,000 bags of flour, rice, and malt.

The first problem was to get out the lumber and the flour, both of which floated and handicapped the divers continually; next it was essential to success that the rice and malt be sent up to the surface; and then, with the way cleared, the menacing glassware was carefully hoisted from the hold. And now we come to the first of the novel expedients resorted to in dealing with the problem. The flour, owing to its buoyancy, crowded upward in the cargo space and packed itself tightly in the upper section of the hold on the higher or starboard side and well above the lower projections of the hatch coamings. It was out of the question for the divers to pull these bags down several feet and shove them into the hatch openings so that they might rise thence to the surface. Accordingly, compressed air was fed into the upturned area in sufficient quantity to force the water level lower, and this enabled the divers then to push the bags of flour with comparative ease into the hatchways—their buoyancy serving to complete the rest of their journey upward.

But the malt and rice did not lend themselves to the same solution. Each package of malt weighed something like 200 pounds, and was held in two bags—the inner one being of a more closely woven fabric. Let it be recalled that tidal conditions were so troublesome that divers could work during the day but a maximum of four hours just before and after the slack of low water; and from their very nature the bags of malt and rice could not be dealt with quickly and in considerable numbers within so brief a span unless means could be devised to make them easier to move from where they were stowed to points vertically in line with the uncovered hatches. This was achieved by giving the bags, so to speak, hypodermic injections of compressed air—enough of this air being retained in the mass to make it slightly buoyant. In this condition the malt and rice could be shifted to positions whence they would float free to the surface. The "needle" for this work was fashioned of a short length of brass pipe pointed at the outer end so that it could be jabbed deeply into the package of malt or rice. The apparatus was fitted with a valve, and was connected to an air-supply hose. The double bags enveloping the malt and the glutinous condition of the wet rice immediately next to its container tended to confine the air for a while.

By reason of skillful use of this ingenious makeshift, this part of the cargo was disposed of rapidly. How thoroughly the men did their work under water is evidenced by the fact that when the "Canadian Recruit" was refloated only four bags out of a total of 4,500 remained inside of her.

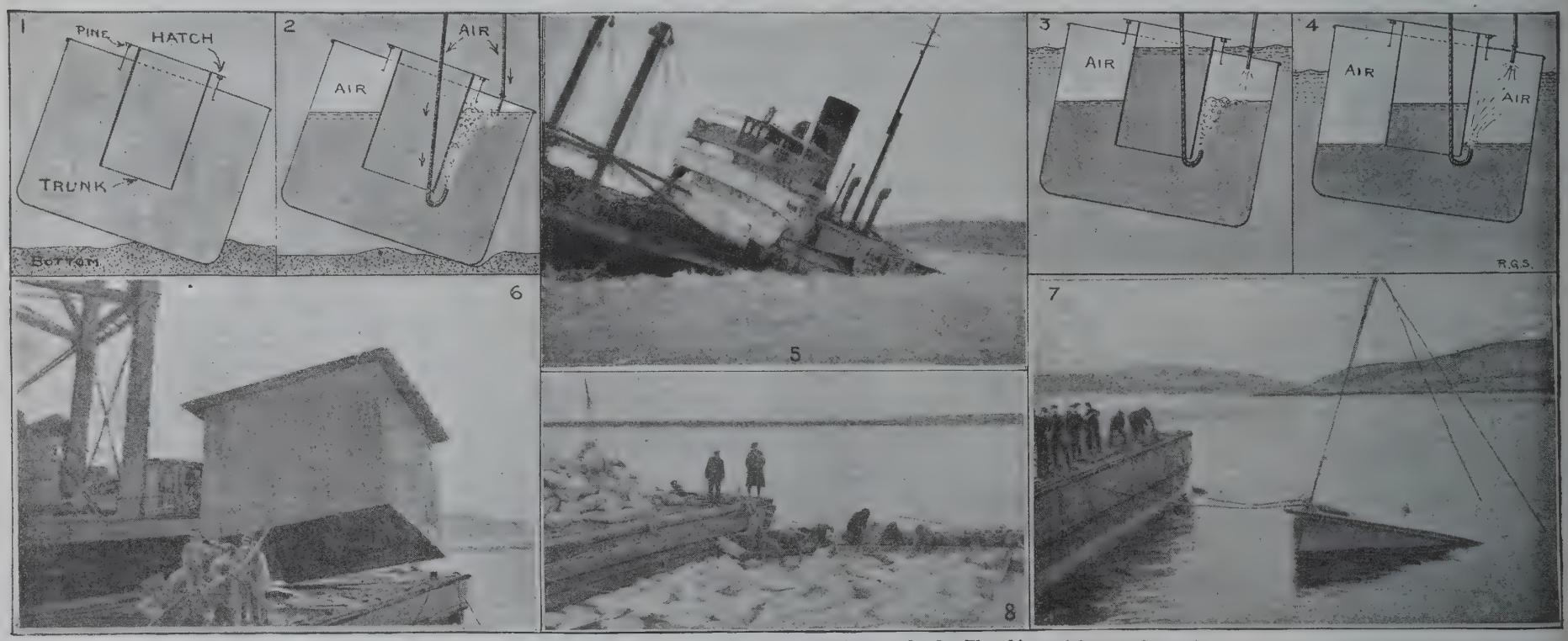
With her after hold cleared and some of her cargo taken out forward—a considerable amount of it had to be left in to insure the craft's stability when again becoming water borne—the salvors displayed their highest skill in bringing the submerged after body up. The fore-and-aft trim of the steamer, her marked heel to port, the depth of water over her deck under the most favorable condition, and the sweep of strong currents made it impracticable to have recourse to cofferdams reaching from the hatches up above the surface of the St. Lawrence. There were no lifting vessels to be had capable of bodily raising the dead weight involved, even if wire hawsers could have been got under the wreck; and to seal her hatches and pump her cargo space full of compressed air was deemed too risky—the wreckers fearing that the expansion of the confined air, as the boat rose surfaceward and the hydrostatic pressure dropped, would blow up her decks unless rather complex measures for the relief of the air could be installed.

The means finally adopted were two steel trunks—really great metal boxes devoid of tops and bottoms, and fashioned large enough to slip freely into the two rectangular deck openings. At the top of each trunk there was attached a wide projecting brim or collar, and this had spread enough to reach beyond the hatch coaming. On the under side of this brim was secured a white pine plank, 3 inches thick, and upon this yielding material the trunk settled against the hatch coaming and was drawn tight by numerous hook bolts—thus providing an air-tight seal. The diagrams accompanying this article show how the trunks reached deep into the hold and were, in effect, in-turning bottle necks.

Their purpose was to permit the cargo space to be filled with buoyant air under pressure and yet to supply a medium for the automatic release of that pressure in a way that would not endanger the hull structure as the steamer lifted clear of the bottom—in short, to act as an elastic cushion capable of equalizing and balancing the opposing air and water columns.

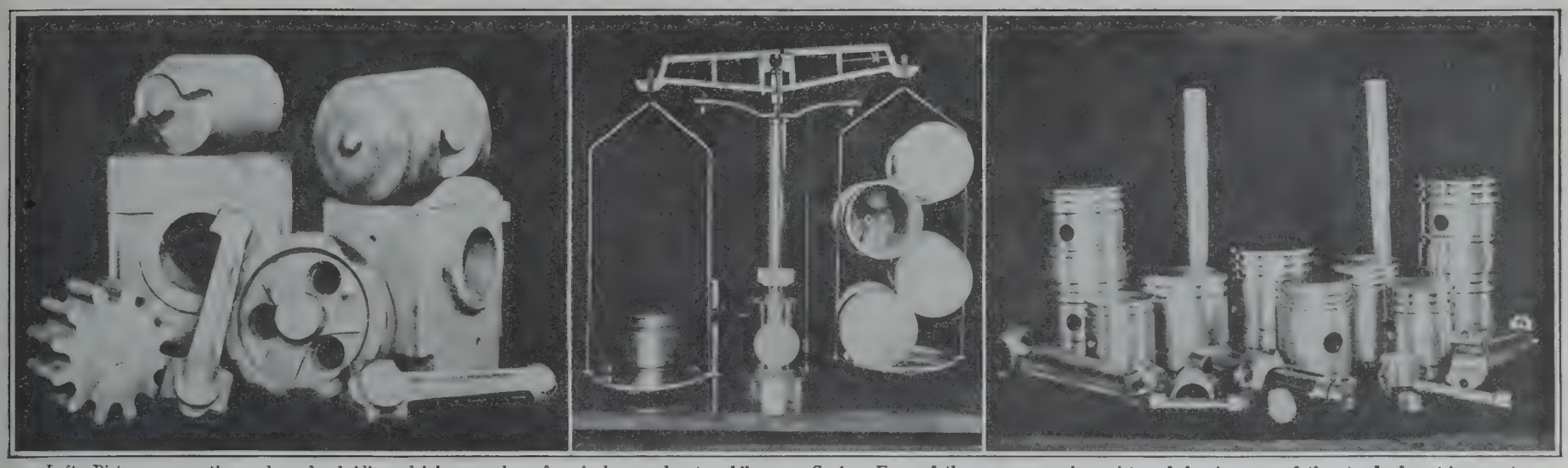
Two channels were used for distributing compressed air in the after hold. One was a connection, made through the deck, to which hose was attached, and the other was a metal pipe, having an upturned or hooked

( *Continued on page 531*)




1. Original position of ship, showing a trunk installed. 2. Admitting air to cargo space to start the vessel upward. 3. The ship arriving at the surface. 4. The craft just before attaining the maximum buoyancy imparted by the compressed air. 5. "Canadian Recruit" at low water. 6. One of the trunks being loaded for transportation to the wreck. 7. A trunk being lowered into position in one of the hatches. 8. Impounded bags of malt and rice brought to the surface by hypodermic injections of compressed air.

**Some of the unusual details of the salvage operations on the "Canadian Recruit," ashore in the St. Lawrence and for many months at the mercy of wind and tide**



*Left:* Pistons, connecting rods and subsidiary driving members for airplane and automobile use. *Center:* Four of the new magnesium pistons balancing one of the standard cast-iron sort. *Right:* Pistons, connecting rods, bolts and nuts, showing bright finish in contrast to the dull finish of those pictured at the left

**Some of the ways in which the new alloy of magnesium is used for automotive parts**

## A New Magnesium Alloy for Motor Pistons

By George Gaulois

A NEW alloy of magnesium has appeared which is offered as the lightest metal to be used for pistons for automobile or airplane engines. It is the lightest metal known which is adapted to commercial uses. Magnesium constitutes ninety per cent of the alloy which differentiates sharply between this new alloy and other light alloys on the market which are made up mostly of aluminum and contain magnesium only in small quantities if at all. Some of the striking quantities of the new alloy, Dow metal, are due to the presence of magnesium which is the lightest metal possessing high tensile strength and physical properties rendering it suitable for engineering uses.

This new alloy has been brought to the attention of engineers within the last year. Prior to the war, magnesium was imported from Germany and its main, if not sole use, in the United States was as a deoxidizing agent for non-ferrous metals. The new alloy is one-fourth the weight of cast-iron and one-third lighter than aluminum. When the foreign supplies were cut off early in the war, the manufacture of metallic magnesium was undertaken at Midland, Mich., there being unlimited amounts of the raw material in the brine pumped from the numerous wells there, from which many other chemical products were manufactured. Among these manufactured products is the salt, magnesium chloride, which after suitable preparation is used for the manufacture of metallic magnesium. The process employed is electrolytic in which a heavy direct electric current is passed through a molten salt bath, maintained at a red heat until it is decomposed by the current and the metallic magnesium is formed which, on account of its extreme lightness, rises to the top, floats on the surface of the molten bath and is skimmed off from time to time.

In the past the demand for magnesium was limited, because no alloy of it had been discovered which possessed the mechanical properties necessary for its use in practical construction of the parts in automotive and aircraft production. But after much experimenting and after many tests, the present alloy was obtained. The main use found thus far has been in the manufacture of pistons for automobiles and airplanes, as well as motor boats. Possessing a tensile strength of from 22,000 to 25,000 pounds per square inch, it is also the lightest material used for such purpose, besides having no abrasive or scoring action on cast-iron cylinders and having approximately the same coefficient of expansion as other light piston alloys. This metal differs from aluminum as to the expansion under heat in a motor in that there is no permanent growth or set at these temperatures. Recent tests have shown that with 21 successive heats made for two hours each and for 0 to 800 deg. F. the permanent growth is so minute that it cannot be detected with a micrometer.

In machining no cutting compound is used and with the lathe running at the highest speed, there are no hard spots. Great resiliency is shown by recent tests at the Government laboratories at the McCook Aircraft Field, Dayton, Ohio, in which a piston was placed in a vise and forced in one-fourth inch and, upon being released from the vise, came back to size with the exception of being only 0.004 inch out of round.

The table gives the important physical properties:

| | |
|---|---|
| Specific gravity | 1.79 |
| Tensile strength, lb. per sq. in. | 22,000 to 25,000 |
| Yield point, lb. per sq. in. | 12,000 to 14,000 |
| Compressive strength, lb. per sq. in. | 45,000 |
| Elongation, 2 in., per cent | 3.5 |
| Reduction in area, per cent | 3.5 |
| Modulus of elasticity | 9,000,000 |
| Brinnell hardness | 55 to 75 |

(*Continued on page 531*)

## A Giant Ingot-Mold Casting in the Making

By A. R. Surface

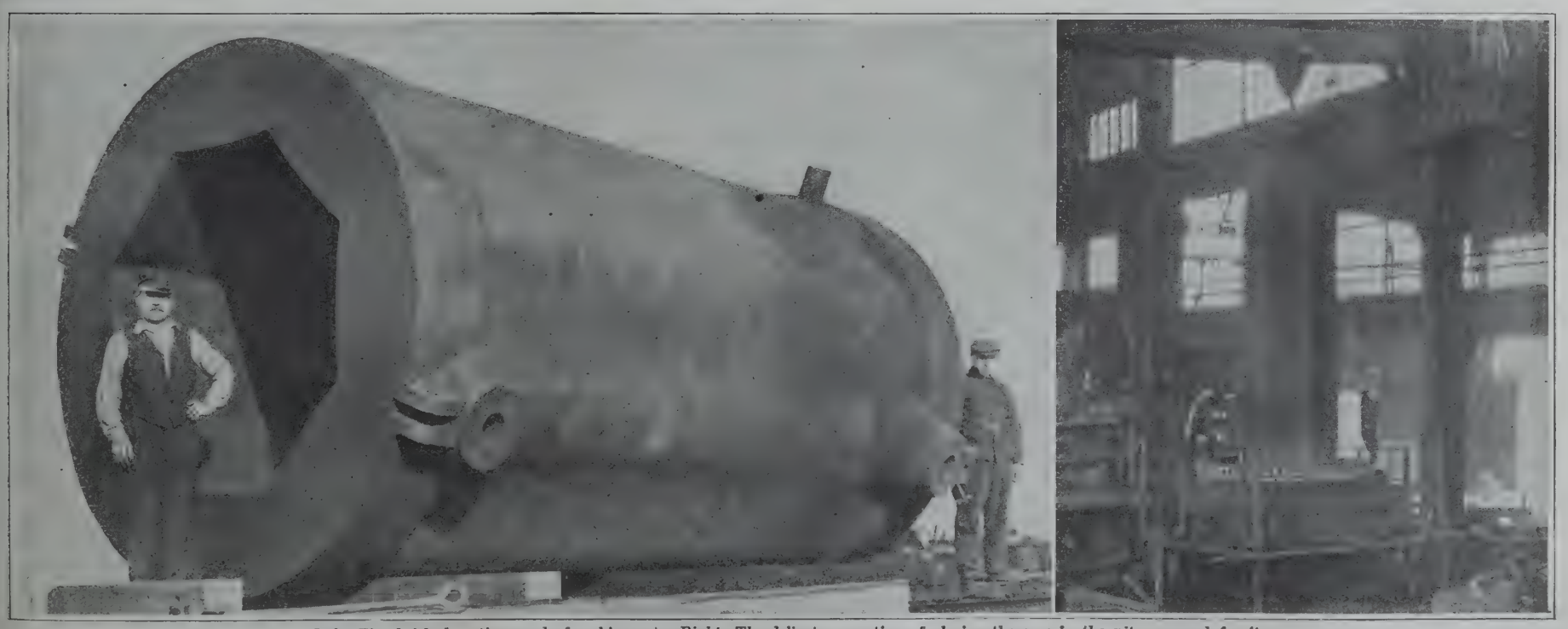
ALL steel when made in any kind of furnace or by any process is poured into some kind of a mold. If the steel is later to be forged or rolled into some kind of shape it is poured into iron molds called "ingot molds." If it is to remain as a casting and used in the form in which it is poured or cast, it is poured in a sand mold and when cool, shaken out as a finished casting.

For some special forgings very large ingots of steel are required. This applies usually to large marine engine forgings or to propeller shafts, etc. Such an ingot mold for such a purpose and its method of manufacture is represented by the illustrations. It is of unusual dimensions and weight and its pouring and molding involved difficult problems, particularly as regards the core which forms the hollow part of the ingot mold and which corresponds to the steel ingot that is desired.

In order that a thoroughly sound casting might be obtained, it was poured on end. To accomplish this, the mold in which the casting was made was erected in a molding pit extending 14 feet below the floor level. Due to the fact that water is reached at 8 feet below the floor line, it was necessary to make this molding pit absolutely water tight. In pouring castings of this character on end, it is necessary to cast large risers or headers on the casting, so as to provide a quantity of metal upon which the casting itself draws as it cools, thus filling up holes caused by contraction. An experienced foundryman will appreciate the difficulties encountered in pouring on end a casting of this weight and character.

One of the important requirements was that the diameters of the mold should be the same at both ends.

(*Continued on page 532*)



*Left:* The finished casting ready for shipment. *Right:* The delicate operation of placing the core in the pit prepared for it

**How a giant ingot mold of steel is cast on end in a pit**

# Aircraft of the Future

## A Statement of What Remains To Be Done, and the Directions in Which the Doing Seems to Lie

By C. H. Claudy

ACCORDING to their advertisements you can, for a dollar, get a "crystal reading" or a "spirit prophecy" or a "delineation of your future" from dozens of "mediums." According to universal human experience, prophecy goes wrong more often than it comes out according to specifications. So let it be said at the outset that this "delineation of the future" of the airplane is not intended as a prophecy but as a sober exposition of possibilities, based on a statement of the unsolved problems in aeronautics as formulated by no less a body than the National Advisory Committee for Aeronautics, instituted by Uncle Sam and transmitted in the form of an elaborate report to Congress by President Wilson.

If the future ever is foretellable in the way which will have credence from men of science, it will be merely as we foretell eclipses of the moon—by a thorough knowledge of the laws governing the phenomenon. It is a familiar truism that the unsolved problem of today is the commonplace of the morrow, always providing that the unsolved problem has a sufficient demand for solution to interest brains and money in its solving.

In spite of the fact that the United States is woefully backward in all that appertains to aviation, the world has demonstrated that the art of flight has come to stay and is to play a great part in peace as well as in war. The stern necessity to solve the unsolved problems of today will as inevitably solve them, as stern necessity devised the audion, ductile tungsten, the X-ray and a thousand other marvels. Simon Newcombe demonstrated mathematically that man could never fly a heavier-than-air machine. It was accepted as an axiom that the composition of the stars was unknowable—until Fraunhofer came on the scene. Always, when the demand has been great enough, we have solved our problems. To state, then, the problems yet unsolved is to foretell to some extent what the future may be.

### With What Shall We Build?

The committee lists as the first outstanding problem in airplane construction the matter of material. It lays down this as axiomatic: "We may, however, be well assured that however good may be any solution we may reach of the many problems presented to us in the industrial arts, there are, as a matter of fact, series of better ones only waiting our patient study." In other words, no matter how skilfully we use wood or metal or wood and metal to make a skeleton and fuselage, there are better ways and better combinations possible, and unknown possibilities in the use of new alloys, and some of the new steels of unheard of strength for their weight. That the optimum construction even with present materials has been reached is not admitted by the committee; that untouched fields in materials, forms, and combinations lie waiting the investigator is stated as a fact. It can then be predicated upon the whole history of construction of other bodies which must at the same time be strong and light, that the airplane of the future will be in all probability built of metal rather than of wood, and that its strength will be no less in proportion to its weight than today, and probably much greater.

The problem of materials is so closely bound up with the problem of size that the two can hardly be considered apart. The committee asks of size "Is there a limit? If so, what is it? Why is it? And how may it be removed or extended?" and then proceeds to answer itself by stating the factors of the size limit as we know them today. Weight increases as the cube, while areas of supporting surfaces increase as the square, or dimension. It seems obvious enough, then, that taking any given speed of plane and size of power plant as a standard, there must come a point when the whole cannot be made larger without becoming too heavy to fly.

### The Problem of Size

*Yet these same laws obtained when Wright first flew in a forty-foot plane, and when the huge Capronis of today were not even dreamed of.* We have escaped this law so far and there seems no reason to think we may not continue to escape it. We escape it by the simple trick of not enlarging our planes as a whole. We do not make a big plane line for line like a small one. We do not have to make a large wing geometrically similar to a small one. We can lighten as we enlarge; lattice takes the place of solid, tube replaces rod. Moreover, the wing, which supports, weighs least of any of the three great members of a plane—wing, fuselage and power plant. We may extend wing area and get increased lift without even squaring, let alone cubing, the weight—if we can engine the whole. If we can master the aerodynamic problem of multiplying wings without interfering the one with the other, there may be no limit to the size of our future planes.

We can safely prophesy, then, that when the demand comes for a huge plane, capable of carrying not its tens and twenties but its hundreds of people, not its ton or ten tons but perhaps its hundreds of tons of weight, there is no structural or scientific reason why that size should not be had. In other words, the plane of the future will be to the plane of today what the "Leviathan" of the sea of today is to the "Clermont" of yesterday.

No one familiar with airplanes of today who knows that as speed increases wing areas diminish, and that as wing areas increase speed diminishes, but understands the real need for some practical plane of wing-area variation during flight. A very high-speed machine is a dangerous thing when it comes to landing if the field is not huge and smooth, because it must land at high speed. A plane that lands safely on fairly rough ground can accomplish little in speed. Either variable areas or variable camber (curvature), or both, may easily be accomplished upon the designer's board or in model form, but so far no wholly practical solution of the problem in actual machines has been attained.

It seems obvious, therefore, to say that the plane of the future will have the speed of the high-speed planes of today and the safety and slowness of low-speed planes of today, at will. Indeed, a completely successful variable-area and variable-camber wing outfit would probably solve the problem of the landing field and permit landings in small spaces, perhaps even upon the roofs of city buildings, and yet with safety.

### The Engine and the Fuel

The problem of motive power is in a constant state of flux. No consideration can be given to it without drawing an immediate dividing line between the probable and the possible. The probable power of the future in the light of the present is an internal combustion engine presumably burning gasoline or other light volatile liquid. The possible powers are numerous—wireless power, electric power, liquid gas power, high-explosive power, steam power, bithermal power—all these are possible in the sense that they are yet largely untried. The committee confines its attention to the probable development of existing airplane engines, and lists among the main outstanding engine problems the problem of fuel, the problem of how much power to an engine, of how powerful a power plant may be, the carburetor, of ignition systems and of maintenance of power at high altitude. The committee finds that the present-day refined motor fuel for aviation engines nearly approaches the ideal; "a long look ahead shows that a serious problem must be met before many decades," and the committee makes no suggestion in regard to what will happen "when present petroleum sources will no longer yield the supply we now use."

"How much power can we put in an airplane? How much power from a single cylinder? A single engine? A single airship?" The committee sees nothing in the way of multiplication of cylinders in one engine up to eighteen, and nothing in the way of multiplication of engines even beyond four. It does not believe much more than forty horse-power per cylinder can be developed along present lines or that cylinders can become much larger but figures that if a 2,500-horse-power power plant is called for, it could be designed (several engines) and that even larger collections might be possible. It defines the limitation largely as a problem of cooling, but it seems safe to state that the airplane of the future will have all the power it needs unless, indeed, its needs become Gargantuan beyond present-day visions of possibilities. None foresaw the enormous horse-power of ocean vessels of today when steam was first applied to ship, or of locomotives when the Rocket first puffed her uneven way, or of automobiles when Daimler first chugged in his one-lung vehicle.

### Mixing the Fuel and Touching It Off

The carburetor is still an unsolved problem for the automobile: much more so for the airplane, which changes its level by thousands of feet. That the airplane of the future will be independent of pressure and chemical-constitution-of-the-air variations due to altitude seems unquestionable. Whether by forced air feed or an oxygen tank or some other method must be left to the future to decide. Whatever the solution the carburetor of the future will function as well at high altitudes as at low ones, will supply an even mixture for each and all of any multiplicity of cylinders, and an even quantity of mixture to each cylinder, will not be affected by changes in inclination and will be accident-proof, that no failures occur in mid-air.

Ignition is still a problem, strange though the word sounds to those who marvel at the perfection of generator, battery, magneto, wiring diagram and spark plugs of today. The committee says: "If we can anticipate the explosion engine of the year 1970, assuming that our grandchildren are still dependent upon hydrocarbon fuels at that date, it would seem as though some more simple and direct mode of initiating the combustion in the cylinders would have been found. On the law of probability the chances are overwhelmingly against our having at the present moment developed the very best method of ignition." This would seem to presage some sort of thermal tube, or even ignition by compression, *à la* Diesel engine, but the present scribe ventures no further than to state the apparent fact that the airplane engine of the far future will not depend upon a complicated and delicate electrical system to fire the charges in its system—at least not if careful research can find a better and simpler way.

### Divorcing Power from Altitude

An airplane normally loses horizontal speed as it ascends to higher altitudes. The reason is in the one factor which remains fixed while everything else changes with altitude. That one factor is the weight which, while it does change mathematically with removal of the mass from the center of the earth, does not change practically. While decreased supporting power of the air (due to its rarity) is compensated for by decreased resistance as far as headway is concerned, it is nevertheless true that the weight, remaining the same, must be kept up in the more rare medium by a greater angle of attack of the wings upon the air, which, drawing from a fixed amount of power, requires more power for translation into weight support and leaves less for propulsive effort. Moreover, while the same amount of cubic-inch displacement remains in each cylinder regardless of altitude, what goes into the displacement is less and less as altitude gets greater and greater. The plane which is normal-powered for low altitudes is under-powered for high altitudes. That some solution will be found, either in design or in the use of air compressors, seems obvious. Certainly the airplane of the future is not to be handicapped by

(*Continued on page 532*)

*SCIENTIFIC prophecy is frequently referred to as a very dangerous game. Under some circumstances it is dangerous enough, for, as we have recently pointed out, if the scribe knew the direction in which the ship of discovery ought to be piloted for greatest success, he would be at the helm instead of on the dock awaiting her return. But Mr. Claudy exhibits the other side of the picture when he reminds us that in many cases a mere statement of the problems unsolved is apt to be a pretty definite forecast of the direction to be taken by the effort at solution. Especially is this the case in an art so definitely mechanical as that of flying. So we feel that Mr. Claudy's remarks should perhaps be taken a little more seriously than we are accustomed to take the scientific prophet. The airship of the future must exhibit many of the features which he suggests.*—THE EDITOR.

# The Five States of Matter

## Two Fundamental Conditions That Must Be Recognized, Besides the Solid, Liquid and Gaseous

MATTER may be defined as that which occupies space, possessing therefore comparative weight. This definition does not denote the physical characteristics of matter, but it is now generally conceived to be capable of existing in five specific forms, each having its own characteristics but capable of assuming the characteristics of another state under certain definite conditions.

The physical properties of three of the five states of matter, namely, the solid, liquid and gaseous, are so well known that only a concise mention need be made concerning them, says the *Bulletin* of the International Metallurgical and Chemical Society. Regarding the other two states, radiant and ionic, less is known concerning their physical identity and characteristics, so that it becomes necessary to study them through the phenomena that they are capable of exhibiting, and not through themselves. This may seem strange to say, or it may appear contradictory, insofar as previously stated that matter must have weight, whereas we cannot study radiant and ionic matter directly, but through the characteristics that they possess. When studying electricity, we do not study it directly, but study the effects of it.

The most recent investigations and researches dealing with the nature of matter, point in the direction of the electrical identity; that electrical charges, both negative and positive, are the cause of and constitute all matter. Now matter must possess weight (truly), so that if matter is composed of that phenomenon known as electricity, why, the source of it must possess weight in the first place. Briefly stated in the words of that great scientist, Benj. W. Sands, "what equals one thing must equal another." If the essentials of the electrical theories of matter are held as probable (and there is no doubt but what they are as reasonable expositions of matter as the accepted atomic and molecular theories), the relation and interrelation of the various states can be readily accounted for, together with the correlation of energy and many other phenomena which previously were considered complete or veiled mysteries.

The importance of a thorough investigation and understanding of matter from a chemical aspect cannot be overestimated. First, chemistry is the science which deals with matter (the elements, their compounds, mixtures and characteristics); in the second place, chemical reactions and interreactions can account for many of the phenomena which formerly were considered purely physical; then in the third place, in order to understand energy and the correlation of the forces, it is necessary that a solid foundation be established concerning matter, and its cause. When one fact concerning matter or its cause is firmly established, we have a basis from which to work and investigate further.

*Solids.*—A solid substance is a body at ordinary temperature and pressure which can retain its original shape to a limited extent.

"A solid is a body which, at ordinary temperature and under slight pressure, does not change its shape." —Hoadley.

*Liquids.*—Liquids or fluids are bodies which, upon slight pressure upon the surface, give way in the immediate vicinity. Liquids have definite size, but they take the shape of the container and have a free surface.—Carhart-Chute.

*Gases.*—Gases are bodies which are in suspension, being neither solids nor liquids. Gases possess some of the qualities of both solids and liquids; *i.e.*, they cohere, and give way under pressure.

A gas is a body whose internal forces do not constrain it to assume any definite volume or form. It expands in all directions. . . . When confined in a closed vessel, it exerts pressure upon every part of the surface which envelops it.—Magie.

*Radiant.*—Radiant matter is that which is existing capable of being transferred from one substance to another, or being condensed and focused. Light and heat are the two most common occurrences of radiant matter. Of course the argument that is still advanced that light is not heat, may be considered, but the fact that radiant heat traverses space with the same velocity as light tends to disprove that theory, so that with great probability, if not certainty, light and heat may be considered radiant matter or varieties of it. One of the characteristics of the radiant state is that it is capable of passing through certain substances without being perceptibly absorbed. This is not a true scientific statement, insofar as probably there are no bodies that are perfectly diathermanic.

*Ionic.*—Ionic matter is capable of being transferred through space without changing its natural state. It is capable of existing anywhere and might be termed etheric or kinetic matter. It is the unity atom, potential matter, or the protyle of Sir William Crookes. It is the cause of the evolution, or genesis, of the elements, together with its accompanying phenomena. It is the electrical phenomenon responsible for all matter.

It differs from the other four states, as it is invisible, so indefinitely small that it possesses the property of being able to penetrate all other matter, but still so great in latent properties that under certain conditions it is responsible for other conditions and states of matter.

As is noted, the differences between the five states of matter are very indefinite, in fact, so obscure that they terminate into each other. It is similar to those (literal) changes of matter which some state are physical and others chemical. However, when the true nature of these changes is understood, it is probable that it will be able to account for these properties.

In studying the states of matter, the idea of the law of periodicity or the cycle law, such as has been demonstrated by Mendelieff and Meyer, in the formulation of the periodic table through the grading of atomic weights, and by Sir William Crookes, through his differentiations of protyle by means of the vibration frequency and space of the hydrogen atom, has been forced to be taken into due consideration. To illustrate the law of periodicity or scientific equality, if the ionic state of matter is responsible for the radiant state, the radiant for the gaseous state, the gaseous for the liquid state, the liquid for the solid state, could not this process be reversed when the last named state is reached and it be responsible for the ionic state, therefore a cyclic process? Or upon the hypothesis of Sir William Crookes, the unity atom being hydrogen (?), the differentiation of the elements and its various states can readily be explained.

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### Power from the Thermocouple

To the Editor of the SCIENTIFIC AMERICAN:

I have noticed in several recent issues of the SCIENTIFIC AMERICAN and of the SCIENTIFIC AMERICAN MONTHLY articles relating to the approaching time when our visible fuel reserves will be exhausted. One article in particular whose title and author I do not remember, mentioned the sun, the tides, the internal heat of the earth, the wind and water power as being sources from which we can draw our power and heat in the future.

We all know of the experiments which have been conducted in Egypt and elsewhere in the generation of steam from the ordinary heat of the sun concentrated by mirrors or lenses upon a boiler. The chief difficulty of this lies in its inefficiency and in the large and expensive layout necessary in proportion to the power secured.

It has frequently occurred to me that the principle of the thermal couple could be utilized to advantage in turning the sun's heat directly into electric current, eliminating much of the heavy complicated machinery now necessary to do the work.

The thermal couple as it now stands is of course extremely inefficient; though I do not think it is more so than were the earliest motor generators; and it would probably not be impossible to develop it to compare favorably with motor generators of today in efficiency. It is at any rate a promising field for research and experiment. A large number of such couples could be connected in parallel, the joints being flattened to receive the sun's heat from a wider area and sheltered from wind to prevent any cooling effect. The cooled joints might be buried deep in the earth or cooled by running water or in any of a variety of ways. Extensive plants could be erected on the deserts of Nevada and Utah and current transmitted on high tension lines to neighboring cities. Or it might be that Marconi's suggestion of wireless transmission of power could be developed so as to be used to advantage.

At any rate there is approximately a horse-power in sun's heat going to waste on every square yard of that desert country, which would be well worth going after.

In regard to the use of the wind as a source of power the writer of the article above referred to made the objection that a windmill which is strong enough to stand up against heavy gales is too cumbersome to be moved by light breezes. While this is perfectly true of the ordinary type of windmill it is still possible to construct a wind-power machine which is neither too heavy for the lighter breezes nor too weak to resist the heavy gales. I know of two general types of machine which would satisfy these requirements, one being on the order of the centrifugal blower which is used to ventilate our large industrial plants, the other being in the form of a helical screw upon an axis fixed in a tube with a flaring mouth to concentrate and increase the velocity of the wind in the tube. This flaring mouthpiece could be used upon any type of wind machine and would have the same effect of an increased diameter of wheel without adding to the weight of the moving parts. Automatic arrangement could be made whereby it would be removed or rendered non-effective when the wind reached a pre-determined velocity. There are a number of other ways in which a battery of wind machines could be regulated so as to produce a fairly constant current.

These are suggestions which may be of interest to any of your readers who are equipped for research work along these lines.

New York. LEO G. HALL.

### Two Problems That Are With Us

To the Editor of the SCIENTIFIC AMERICAN:

I have been very much interested in the Einstein theory, but have not been able to learn much about it except through a few popular articles that were not written by any of the famous twelve. I hope that in the articles that I understand you are going to publish on this subject that you will not bury the facts under the mass of glittering generalities that befog most "popular expositions."

This seems to me to be a suitable time to add a few remarks to the many that have already been said about Mars. Starting from the supposition that the inhabitants of Mars differ from us no more than the Chinese do, there would still be no possible way to prove that any signals that might be exchanged were the result of intelligence and not the accidental working of nature. The only way communication can be established that would defy argument would be for some person actually to visit Mars, the arrangements for the trip being under the auspices of some institution whose prestige would be a guarantee against trickery. Such a trip is not impossible but the difficulties in the way would probably prevent its accomplishment at present.

Camp Lewis, Wash. CAPT. A. R. ROCKWOOD, C.A.C.

### Twins

To the Editor of the SCIENTIFIC AMERICAN:

In discourses on heredity I have often seen it mentioned that the tendency to have twins is hereditary, or "runs in families"; but there is what appears to be another fact regarding the twins tendency that I have never seen in print and hence doubt that scientists have noted it. This fact is, that the mother of twins will almost always be found to have had an unusually large number of brothers or sisters or both; while the father in a good many cases may have had but few or none. As local registrar of births and as a member of this community for many years, I have been unable to find a single instance in which a mother of twins did not have at least five and sometimes about ten brothers and sisters. This I think could hardly be mere coincidence, and I ask that scientists look into the matter, for it is something that could be easily proved or disproved.

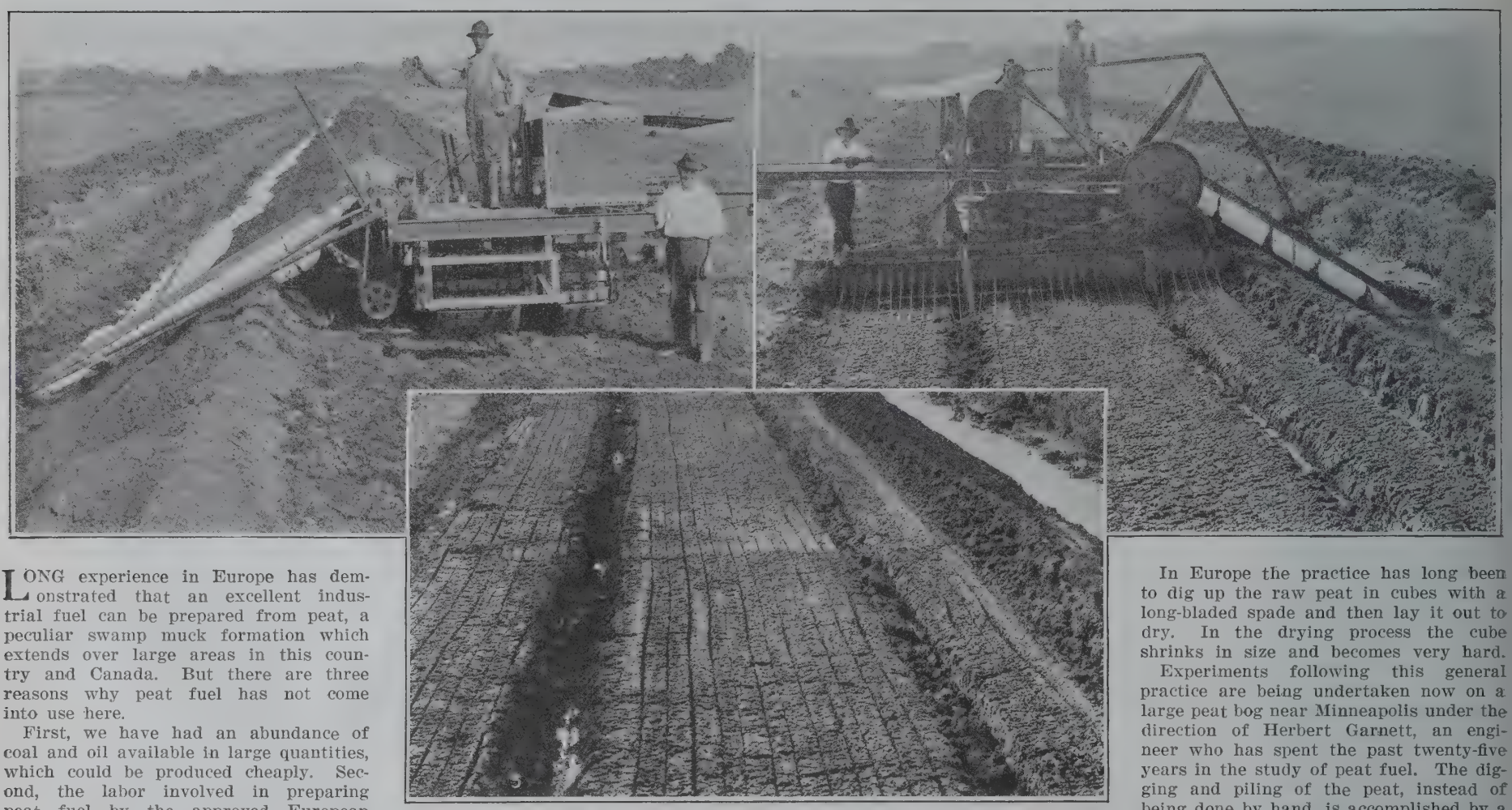
Livermore, Cal. ELMER G. STILL.

[*We know one case where the mother of twins is herself one of five; but this is hardly enough to throw Mr. Still out of court. If any reader wishes to put other cases before Mr. Still the printed address will reach him.*—THE EDITOR.]

# Our Coal in the Making

## America's Peat Bogs and Their Utilization for Fuel

By Harry A. Mount



1. The peat digging and spreading machine, seen from the direction toward which it is progressing. 2. Another view of the machine, from behind, showing the cutters that leave the peat in strips. 3. The bank of peat left in the wake of the spreader

**How peat is being taken out of Minnesota's bogs by machine**

LONG experience in Europe has demonstrated that an excellent industrial fuel can be prepared from peat, a peculiar swamp muck formation which extends over large areas in this country and Canada. But there are three reasons why peat fuel has not come into use here.

First, we have had an abundance of coal and oil available in large quantities, which could be produced cheaply. Second, the labor involved in preparing peat fuel by the approved European method makes it impractical for adoption here. Third, we have lacked adequate machinery for easily converting large quantities of peat into fuel.

As a natural result of these, might be added a fourth reason. Our industrial engineers know little or nothing of the properties of peat fuel and the "technique" of its use has yet to be developed.

The real reason, of course, is our hitherto "inexhaustible" supply of coal. But hardly a day passes now that we are not presented with some new evidence that our coal supply is far from being inexhaustible, and indeed our present supply barely can be stretched to meet our increasing industrial needs. And so our engineers have already turned their attention to peat and the limited development which has taken place holds the promise that before many years we may expect to see our 12,000 square miles of peat deposits supply fuel for many of our factories and utilities, and even our homes.

The files of our patent office bear witness to the fact that many attempts have been made to manufacture peat fuel by a purely mechanical process. These have all been failures because of the nature of the raw peat, which was not thoroughly understood.

True peat is really coal in the making. It consists of age-old deposits of ferns and water plants which have gradually built up a lake into a swamp. The deposit consists largely of partially decayed water plants, which naturally have a large affinity for water.

Raw peat may contain as high as 90 per cent moisture and so far every effort at mechanical elimination of this water has failed, from a commercial standpoint, due to the fact that about 60 per cent of the moisture is held in chemical combination or in minute cells.

The water can be eliminated in mechanical dryers, but more fuel is required to drive off the moisture than the finished product furnishes. Only a small part of the water can be forced out under the most powerful hydraulic press.

The most successful method of elimination, and that used most widely, is the ordinary process of sun drying. About ninety days, however, are required to dry the peat to 20 per cent moisture, when it is suitable for fuel. Operations, moreover, are necessarily restricted to the summer months and to dry weather.

In Europe the practice has long been to dig up the raw peat in cubes with a long-bladed spade and then lay it out to dry. In the drying process the cube shrinks in size and becomes very hard.

Experiments following this general practice are being undertaken now on a large peat bog near Minneapolis under the direction of Herbert Garnett, an engineer who has spent the past twenty-five years in the study of peat fuel. The digging and piling of the peat, instead of being done by hand, is accomplished by a specially designed machine, photographs of which are shown herewith.

The machine digs to a depth of seven feet, the sides of the bank sloping at an angle of 60 degrees. The digging unit consists of a special type worm, having double flights rotating against the direction of travel of the machine. Thus the original structure of the peat is destroyed, the lower layers being mixed with the upper, and the whole mass is delivered into a macerator at a uniform consistency. The macerator consists of rotating knives which further break up the fibers and cell structure of the peat and then the pulpy mass is discharged to the ground just in front of the spreader.

The spreader moves the mass over from the excavation and spreads it in an even layer about four inches thick, the sheet being upward of sixteen feet wide. The sheet is cut into strips as the machine moves along by the cutters as shown in the photograph and it is afterward cross cut by a device not shown.

In each cubic foot of peat as it lies in the bog there is from 10 to 15 pounds of dry fuel, so a large bulk of material must be excavated to produce a ton of fuel—roughly, 7 cubic yards are required. The for-

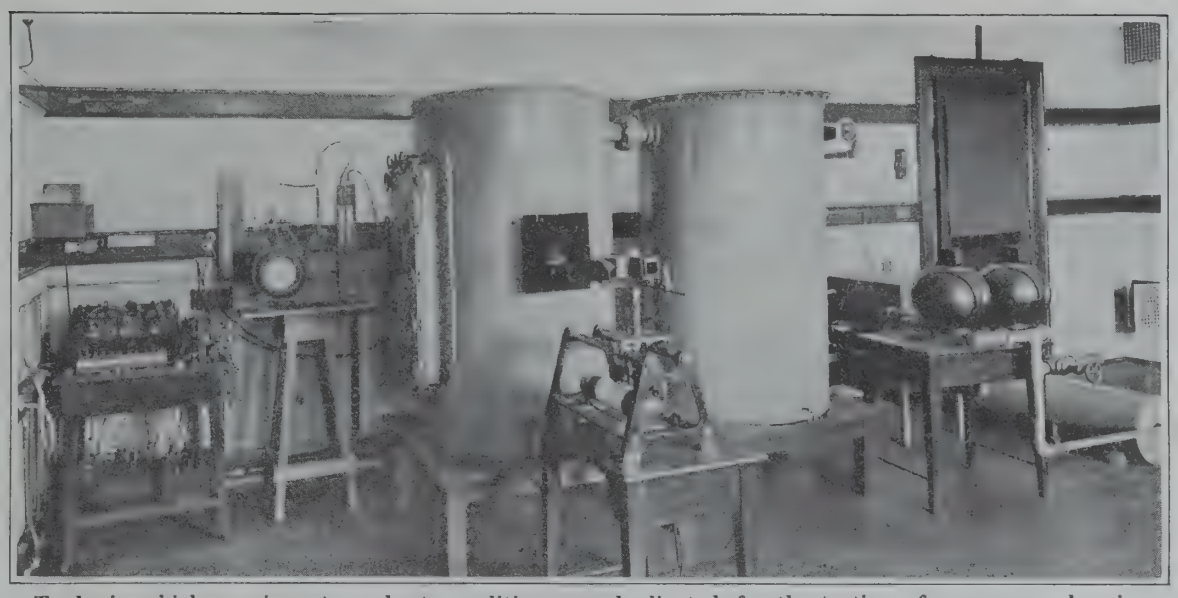
(*Continued on page 532*)

**Piling Irish peat for drying. Practically the entire center of Ireland is a vast peat bog, furnishing an almost inexhaustible supply of the fuel**

## The Atmospheric Tank

TANKS equipped by the National Bureau of Standards are capable of duplicating atmospheric conditions, varying from the driest spell in January to the wettest day in July, as a medium of determining the influence of atmospheric pressure and moisture on the candlepower of gas flames, gas mantels, and kerosene lamps. What effect does a rainy day have on the gas flame or kerosene lamp in your home? is an inquiry not outside the province of this government apparatus.

A constant flow of air at any specified pressure is maintained through the tanks, ranging from pressures of two-thirds to one and one-third times atmospheric pressure. The moisture can be controlled so as to duplicate conditions anywhere between parching aridity and a superabundance of rain. The intensity of the light of the gas flame or kerosene lamp is measured through a glass window in the side of one of the tanks.—By *S. R. Winters.*



**Tanks in which varying atmospheric conditions are duplicated, for the testing of pressure and moisture effects on the candle-power of gas and kerosene flames**

## Producer Gas from Harvest Waste

"CONSERVATION in waste places" is truly a shibboleth all-pervading in its grasp. The evidence is cumulative, the latest innovation being the utilization of wheat, oat, and rye straws in producing gas. The distilled product is the result of tests at the experimental farm of the United States Department of Agriculture at Arlington, Va. An automobile has been propelled with the new combustible and it has been employed for illuminating purposes as well as for cooking. The commercial possibilities of straw gas, however, have not been determined.

The government experiments will relate to the quantity and quality of gas as distilled from wheat, oat, barley, rye, and rice straws, and from cornstalks, corncobs, and other vegetable material hitherto classified as waste. If the scientific investigations at the government farm develop the anticipated commercial possibilities of straw gas, equipment will be devised to facilitate its production by individual farmers. The gas could be utilized in supplying light and heat for the farm home, power for stationary engines, and, possibly, fuel in operating the tractor. Its economic value would thereby be established, conserving raw material frequently burned or permitted to rot in the fields. The supply in the West and Northwest would be practically limitless.

Fifty pounds of straw will yield about 300 cubic feet of gas. Converted into power for propelling an automobile, a light roadster can go 15 miles on 50 pounds of straw. At present, the immediate problem is in the conversion of straw gas into liquid form or condensing it as a possible motor fuel. Among the by-products obtained in the manufacture of gas is carbon residue suitable for making lamp black of fine quality. Likewise, this residue contains limited quantities of potash, phosphates, and nitrogenous compounds of fertilizing value. The tar and ammoniacal liquids resulting from the process, aside from their value as disinfectants and preservatives, may be useful in the dye industry.

Straw gas is not brand new, the process being developed by George Harrison, a Canadian engineer at Moosejaw. The University of Saskatchewan, Canada, installed a straw gas equipment, which was later purchased by the United States Department of Agriculture. The Canadian scientists succeeded in operating an automobile with the product, the fuel supply being transported in a large flexible bag on top of the car. The method, in spite of its wide war-time use in Europe, smacks of impracticability. Still, it may be possible to put straw to some practical use sooner or later.—By *S. R. Winters.*

**Charging a retort with straw for the manufacture of gas**

## The Centrifugal Oyster

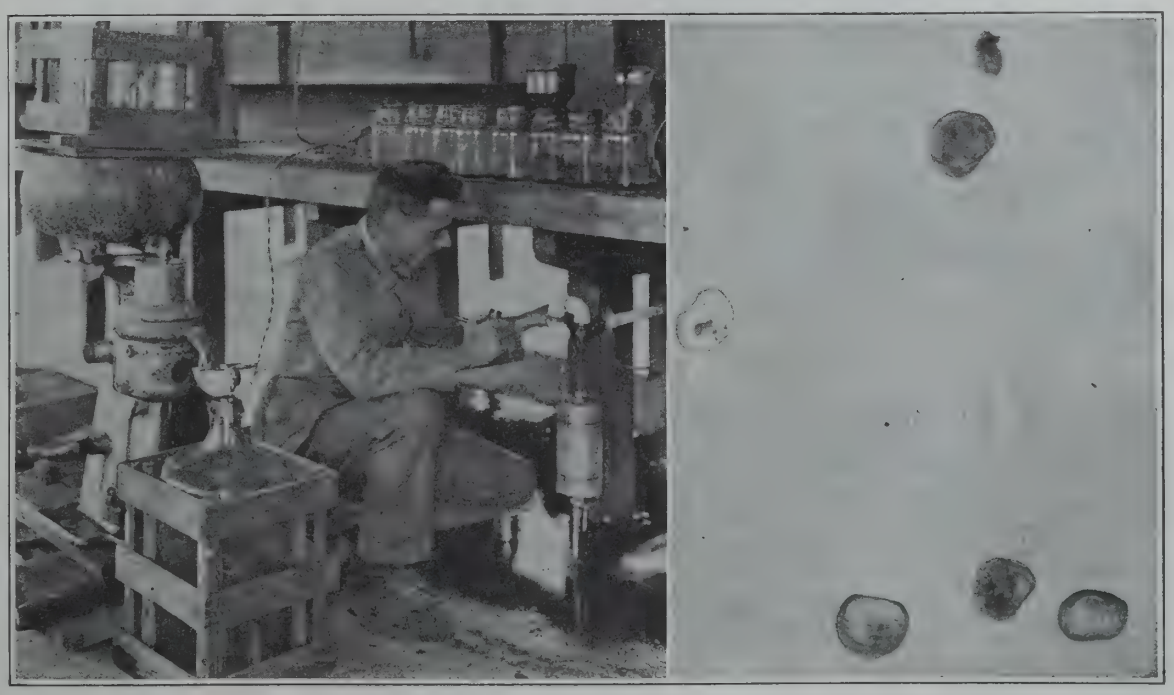
SALVATION of New York's declining oyster industry is promised as a result of the first successful experiments in the artificial propagation of oysters, which have just been completed by W. F. Wells, biologist and sanitarian of the New York State Conservation Commission. The work is part of the broad program for the fullest possible use of the State's natural waters, which is being pushed by the Conservation Commission with every promise of worth while results.

It is a well-known fact that the yield of commercial oysters in the northern and eastern waters has been gradually shrinking within recent years, the main cause of the decline being the continuous and unexplained failure of the oystermen to secure a "set" of young oysters. By "set" the oystermen refer to the habit of young oysters shortly after they have been hatched of sinking to the bottom and attaching themselves to shells and other smooth objects. Once "set" the oysterman can shift his oysters to suitable "growing" and "fattening" grounds, but if the young oysters do not attach themselves to the shells which the oysterman deposits for that purpose, his business naturally fails.

The important facts of Mr. Wells' experiments, which he has been carrying on in an improvised laboratory at West Sayville, L. I., are that he has succeeded in obtaining eggs from oysters and fertilizing them in much the same way as is done with fish in hatcheries, and has then been able artificially to feed and raise the young oysters until they have "set"—a thing which has never been accomplished before. The far-reaching significance of this achievement can readily be seen in the possibility of establishing vast oyster beds in suitable waters from "sets" of young oysters that have been artificially secured. As a single oyster will discharge from 10,000,000 to 100,000,000 eggs each season, the day may be not far off when oysters may come to be a common food of the people instead of being gradually forced into the class of a luxury for the epicure through a failing supply.

The success of Mr. Wells' experiment, where others have failed, has been in the ingenuity with which he has provided fresh food and water for his microscopic charges. Previous investigators have frankly admitted that they could devise no means of changing the water without losing the minute forms, which have consequently started before reaching the "setting" stage. Mr. Wells has overcome this difficulty by using a centrifugal machine, and in this way concentrating millions of little oysters from a large volume of water into a small bowl. They could then be transferred to fresh water containing food and other living necessities. At first it might appear that such delicate animals would be injured by passing through a centrifugal machine, but, being enclosed in shells, which act as a protection, Mr. Wells found that they could be concentrated in the machine without any injury.

About one month after hatching, the little oysters, which are free swimmers during that period, adhere to shells and even "set" in large numbers on the glass sides of the receptacles.



*Left:* Centrifugal machine in which microscopic eggs are separated from the water when it is necessary to change the latter, and glass jars for transferring the resultant "concentrate." *Right:* 14-day-old oysters magnified 100 diameters

**Some details of the artificial propagation of oysters**

# Taming the River Nile

## Construction of Dams and a 225-Mile Canal to Double the Irrigated Area in Egypt

By H. C. Hardy

IT will come as a shock to many proud Americans to know that neither the enormous irrigation project of our far-famous Reclamation Service nor the Panama Canal is destined to remain the largest man-made water works in the world. Egypt, ancient home of the art of irrigation, is to come into its own with an irrigation system which will make ours small by comparison and dwarf the great Aswan (used to be Assuan) storage dam as the Panama Canal dwarfed the Erie.

The matter is of especial interest to us, however, from the fact that in the settlement of the principles which had to be enunciated before this great enterprise could be carried out, an American engineer had a leading part, and because of this settlement a principle of equity in water was enunciated which may have a very large part to play in the relations of the United States with its neighbors, Mexico and Canada.

Most readers are familiar with the part the Nile plays in Egypt; so intimately interwoven with the land of the Pharaohs and the cradle of civilization is its great river that literature and history are filled with it. Thoroughly to understand the present great project, however, it is necessary clearly to visualize not only the Nile as a river, but as a source of irrigation.

An Egyptian cotton field, the main reason for the great irrigation project

The huge river has an average difference between mean and flood water of twenty-five feet. During flood water, since the memory of man runneth not to the contrary, it has been the custom of the Egyptians to cut canals through the banks of the river, draw the water off into the valley of the Nile where it is confined in basins, there to settle and deposit its rich alluvial silt, and later to be allowed to flow back again into the river, less that lost by evaporation and sunk deep into the soil. In a rainless country, the water thus remaining in the unusually rich soil deposited, grows crops with speed and profusion.

The more Nile water which can be used, the greater the area which can be flooded, the more crops which can be grown, the greater the income to both the people and the State (since there is but one tax in Egypt and that upon the land irrigated). No water, no irrigation; no irrigation, no tax. A low-flood Nile has meant famine and starvation and a depleted treasury; a high-flood Nile has meant plenty and great crops and a full treasury as far back through the past as the records of our oldest civilization go.

But, as was natural to an agricultural people who knew nothing of irrigation as a science, the native Egyptian methods are wasteful and inefficient. Moreover, the most profitable of all crops, cotton, must be planted early in the year, at the time of low water, and for cotton continual irrigation is necessary, not merely one period, such as suffices for the maize and grain crops.

To produce water for cotton raising during the period of Nile low water, a great barrage (we should call it a division weir) was constructed twenty miles below Cairo by French engineers. It was supposed to raise the level of the Nile at least fourteen feet, but because of the lack of a firm foundation on which to build and the lack of knowledge of irrigation work at that period, the structure bulged in the middle, cracked, and could safely be used only for a raise of three feet of water. This was in 1880. In 1882 the Allied powers took charge of the chaotic finances of Egypt and English engineers put down a flat weir below the French works, relieving the strain and making the French weir to some extent useful.

The year 1885 saw the long staple cotton crop, which grows only in Egypt and in one small velley in this country, well begun. This long cotton is three times the value of ordinary cotton and of huge profit to the land of Egypt as well as the State. Naturally Egypt wanted to use more and more water at times of low water to grow the crop which brought wealth to both country and grower.

The eminent English engineer, Sir William Willcocks, suggested the great storage dam at Aswan, at the lowest cataract of the Nile, which was begun in 1903. But it was not built as high as he wanted it built because of entirely sentimental reasons—the little island of Philae has upon it a wonderful old ruined temple, which was held by many to be of more importance than irrigation or cotton. To build the dam too high would be to cover the island and the temple. Let no one laugh who reads—the reformer we have always with us and Niagara is, and probably always will be, a bone of contention between the beauty lover on the one hand and the electric industries engineer upon the other.

However, time brings changes and time brought an ever increasing demand for water. Great as was the Aswan dam, it was not great enough, even after it was raised in 1912, to a sufficient height to cover Philae at high water and immerse the temple beloved of historians and archaeologists. Egypt planted more and more cotton and demanded more and more water from low-flood Nile in the spring. There were two and a half billion cubic meters of water backed up behind Aswan dam—two million acre-feet of water, all useful save the twenty per cent lost in evaporation. But it was not enough, especially was it not enough when the war began to demand cotton, cotton and still more cotton, for its textiles and its explosives.

Sir William Willcocks suggested a still higher dam, below Aswan. Sir Murdoch MacDonald devised a plan to build dams above Khartoum on both the Blue Nile and the White Nile, thus going into the Soudan for water, a plan which also included the irrigation from the Blue Nile of three million acres in the Soudan.

To use the White Nile as a source for

(*Continued on page 535*)

1. The existing delta barrage across the Nile. 2. A native village, with sheikh's tomb, in the area to be affected by the latest dam. 3. The great pyramid of Cheops, affording an ancient setting for the works of modern engineers

**Where the world's greatest man-made water works are to be created, in the fruitful Nile valley**

## Keeping Tabs on Bird Peculiarities

**By George H. Dacy**

"AND the birds of the air, they labor not, neither do they spin, yet they know when the summer is nigh," is a Biblical excerpt which appropriately presents our lack of knowledge concerning the everyday doings of the myriads of native birds and which accurately describes their remarkable migratory instincts. Heretofore, sporadic and unsystematic efforts have been attempted on the part of unorganized and indivilual bird lovers and fanciers to ascertain some definite facts and figures on the goings, comings and everyday activities of the birds of their localities. These investigations were, to a certain extent, centralized eleven years ago when the American Bird Banding Association was organized. The recent absorption of this work by the United States Bureau of Biological Survey promises a marked and potential expansion of the investigational activities.

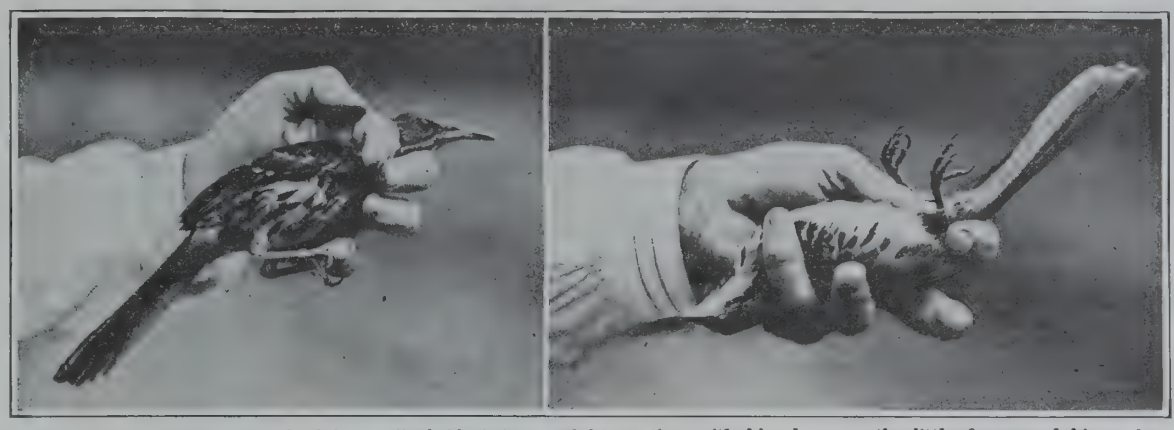
By the systematic trapping and banding of birds for identification purposes, it is possible accurately to keep tabs on the potential operations of a limited number of these birds which react favorably to trapping and which soon acquire the habit of returning, season after season, to the same feeding stations where they were originally caught. A bird soon learns that it is always assured of a square meal every time it visits the feeding station and that it will be given its freedom again after being fed and examined. Some birds such as the cardinals actually become obnoxious around the traps, remaining in the neighborhood continuously, entering the traps and preventing the entrance of other birds. In a word, the free meal idea appeals to the cardinal and, whenever possible, this tramp of the bird family avails himself of lunches of this description.

The English sparrow trap—originated by the national Department of Agriculture for the capture of such marauders wherever they became objectionable and injurious to crop culture—is used chiefly in snaring the wild birds. The trap is ordinarily baited with finely cracked grain such as commonly is sold as baby chick food. The grain is scattered thinly as far as five feet from the trap while crusts of bread are spread inside the wire cage. In the majority of cases the trap is placed on the ground and surrounded by a guard fence of chicken wire about 60 feet in circumference to protect it from the neighborhood cats and pet dogs. Only where it is desired to capture the birds which live in the tree tops is the trap ever placed in a tree.

The preferable time of the year to catch the birds is during their migrations or after they have established their residences for the season, although in most instances the birds respond to the bait at most any period after they have once been trapped. When a bird is captured for the first time, the bird lover should place a small identification band around the leg of the bird. The bands in use at present bear the inscription "Serial Number——, Notify Biological Survey" on one side and "Washington, D. C." on the other. In applying the band it is necessary to hold the bird firmly but gently so that it cannot flutter.

In cautioning the novitiates in bird study about handling the little fliers, a bird expert makes the following suggestions: "For examination, the bird is best held sitting upright, resting with his claws on the little finger, and with his neck between the first and second fingers. In this position the bird will rest placidly, even with the hand left open, so the entire body of the bird may be examined easily. In placing a band, the bird is preferably held on his back, with the little finger snugly over the throat, so that the thumb and first finger are in position to hold the leg while the band is adjusted. A record is kept of the family and species of each bird that is banded so that subsequently this information and his serial number may serve to identify him each subsequent occasion when he visits the feeding station."

The American Bird Banding Association aggregated 350 members, some of whom were expert ornithologists, although the majority were bird lovers and opera glass students without scientific training. During its existence its members banded between 18,000 and 19,000 birds and of this number approximately 375 were subsequently recovered. The mortality in bird life is very heavy and this is largely explanatory of why the recoveries on the part of the average bird student are only two or three per cent of the total number of birds which he catches and bands. Previously, systematic trapping has not been practised as efficiently as it could have been. The experts of U. S. Biological Survey hope to extend the potential recovery record to about ten per cent of the birds which are banded.



*Left:* For examination, the bird is usually held sitting upright, resting with his claws on the little finger and his neck between the first and second fingers. *Right:* In placing a band, the bird is held on his back, with the little finger snugly over the throat so that the thumb and index finger can hold the leg as the band is adjusted

**How migratory birds are examined and how they are labelled by means of leg bands**

In extending its investigations the Biological Survey is extremely anxious to get in touch with all bird lovers in the United States, especially with those who would be interested in coöperating with Uncle Sam in his bird study experiments. All those who now feed birds regularly can assist greatly in this campaign for increased knowledge about the birds by corresponding with Biological Survey, Washington, D. C., in order to be enrolled on the official list of feeding stations and to be provided with government bands and records for keeping track of the birds. At this time, lack of funds prohibits Uncle Sam from furnishing his layman field forces with traps. However he will supply simple plans and specifications so that any tinsmith can construct one of these traps without difficulty. If the bird lover prefers to purchase the trap on the market, it can be secured at a moderate price from Mr. J. Warren Jacobs of Waynesboro, Pennsylvania.

There are three distinct highways of land bird migration in this country where volunteer students can perform effective work. The first line of flight is along the Mississippi River Valley while the other two, respectively, are along the Atlantic and Pacific coasts. It is particularly noteworthy that during the migrations the birds do not make regular flights every day. They stop for some days in sections where the food is abundant and usually will resume their journeys

(*Continued on page 536*)

## How Meadow Mice Destroy Trees

**By William A. Murrill, Ph. D.**

ONE day early in March, I saw about noon at the elevated approach a brown rat, a gray squirrel, and a cottontail rabbit. The first two were actively hunting for something to eat, while the rabbit sat on the snow with its eyes to the sun fast asleep.

The brown rat is always with us, and is not only very destructive but helps to spread many diseases. The gray squirrel continues to be the delight of park visitors in spite of its shiftless habits, its fondness for buds and maple sap, and the fact that it destroys birds' eggs and young birds before they are able to fly. Two specimens of the black variety are frequently seen in the hemlock grove. The cottontail rabbits are fairly abundant in our grounds, making their nests near the buildings and being quite socially inclined. Although destructive in many sections, the injury done by them here is so slight as to be negligible. They seem to stand on top of the snow and reach for the young twigs, which they nip off with a clean cut. I do not know of a single case of girdling which can be attributed to them.

But the common meadow mouse is very destructive every winter, and he was unusually so during the one of 1919-20, doubtless owing to the abundance of snow and ice.

Walk through any grassy meadow and you will notice little runways forming a network over the surface of the soil and winding in and out among the vegetation. These are made by mice about as long as the common house mouse but with thicker body and shorter legs and tail. They keep the runways very smooth and free from straws so as to reach their burrows quickly in case of alarm.

In their comfortable nests of dry grass, several litters of from four to eleven young are reared each year. Hawks, owls, crows, foxes, weasels, and other natural enemies prey upon them continually—and still they increase. They consume large quantities of growing and matured crops and often destroy entire orchards by gnawing the bark from the base of the trunks and roots of trees. In winter they tunnel under the snow from one tree or shrub to another.

**The common meadow mouse, and a young apple tree showing a sample of his destructive work**

No store of food is laid up for cold weather by the southern species, but there is one in Alaska that gathers and hides in its nests a quart or more of little bulbous grass roots, which the Eskimo women search for eagerly and boil to serve to their guests during winter festivals.

To recount all the damage done by meadow mice in their search for food on our grounds during the past winter would make quite a story. A great many different kinds of trees and shrubs were attacked; and the attack was made in different ways according to the quality of the bark, the depth of the snow, the amount of dry grass present, etc.

The object of the mice being to get at the food stored in the inner bark, it was necessary for them first to gnaw away the outer corky layers, after which the tender inner layers were consumed down to the wood. On account of this complete girdling no food can pass to the roots, which will be speedily starved out and the trees will die. In the case of shrubs new shoots will spring up, but this will take some time.

Several of the splendid Japanese flowering cherries were completely girdled for a distance of six inches or a foot near the base. Four of these are young trees, six inches in diameter, and good bloomers; while one belongs to the first lot set out many years ago. Two other fine trees in the cherry orchard are nearly girdled and will either die or become practically worthless.

(*Continued on page 536*)

# The Service of the Chemist

*A Department Devoted to Progress in the Field of Applied Chemistry*

Conducted by H. E. HOWE, Chemical Engineer

## Research in Laundering

INTEREST is being aroused in Great Britain to undertake industrial scientific research in the laundry industry, and as an example of what may be accomplished reference is made to the research work conducted at the Mellon Institute, upon a Fellowship founded by the Laundry Owners National Association. Some of the problems awaiting solution are the economical use of heat and steam power, improvements in the construction and design of washing machines to reduce the mechanical wear on goods to a minimum, and a fundamental study upon the mechanical side of laundry practice involving such factors as time, temperature, and concentration. Then there is the influence of the ironing temperature upon the wear and tear of goods, and research upon the relation of design and weave of fabrics to laundry wear in order that we may choose the fabrics best suited to withstand this wear for those articles, such as collars, which require frequent laundering. The properties and most efficient uses of starch and the removal of old starch are other important fields. The removal of stains and scorch are further problems.

The results of research of this character would not only be of economical value, but would assist us in placing responsibility where it belongs, whether manufacturer, purchaser, or laundry man.

## Clay Soap

IN the January issue of *Chemical Age* (London) Mr. F. E. Weston discusses the utilization of colloidal clay in soaps. According to this writer the concentration of soap on the surface of the adsorbing bodies is the first factor in the detergent action of soap. Soap in water lowers the surface tension of water against air, and clay can be rendered so highly colloidal that it will display the same physical behavior in lowering the surface tension of a liquid in which it is in solution. Therefore, when such clay is properly mixed with soap it increases the detergent properties of it. In fact, it is reported that clay lowers the surface tension of water to an even greater extent than does soap itself, and experiments conducted with high grade soap with and without colloidal clay have verified this assertion. The commercial importance of this work will be in the replacement of a part, at least, of the fatty acids now used in soaps.

## Standardization of Glue

THE present standards by which glues are marketed are arbitrary and unfortunately not based upon scientific data. In the *Journal of Industrial and Engineering Chemistry* for April, George Hopp presents a new method for determining the tensile strength of glue which appears to give the exact strength and stretch of the material, its elastic limit, and other physical properties. Such a test will permit manufacturers to vary their processes and raw materials, determine the effect on the finished product, and permit the establishment of a standard which can be expressed in absolute units determined by scientific methods.

The method consists in melting the glue, pouring it into molds, and obtaining the stretch and strength of the sample on a tensile-strength machine, using cut strips of definite size. The article gives results of the work and outlines at least eight problems now under study to determine the effect of the variation of different factors upon glue.

## The Metallurgy of Tungsten

DR. C. W. BALKE has recently addressed scientific meetings on the metallurgy of tungsten, accompanying his presentation with various samples of this important element which but a short time ago presented what was then one of the most difficult technical problems. It will be recalled that this problem was that of producing ductile tungsten for use in incandescent lamp filaments and that success in this project is largely responsible for the efficiency of modern illumination. Today an equally important use of the element is in the manufacture of high-speed tool steel, in which utilization more impure material can be used than for filaments. The production of powdered metal from the ore is comparatively simple. This material is then pressed into ingots in hydraulic presses developing 250 tons per square inch. These ingots are then heated in an atmosphere of hydrogen to about 3,300 degrees Centigrade, which is just below the melting point, 3,350 degrees, tungsten having the highest melting point of any known metal. This sintering operation is controlled to produce a desired grain size in the mass. The mechanical work in producing pure tungsten wire is complex, and involves heating the ingots in special furnaces in an atmosphere of hydrogen and swaging the heated bars down to required size. The metal is passed through the swaging machine a great many times, as no more than 10/1000 of an inch reduction is accomplished each time. Eventually a size of 30/1000 of an inch is reached, after which the wire is drawn through steel dies until it is 20/1000 of an inch in diameter. Diamond dies heated to redness are now used until 15/1000 of an inch is obtained.

The manufacture of tungsten and its products requires very careful technique using hydrogen under dangerous conditions. It affords an excellent example of the development possible through chemical engineering, involving mechanical and electrical problems as well.

## Isolation of Vitamines

IT seems certain that the study of vitamines will influence our work upon foods to as great an extent in the next twenty years as has sterilization during the past generation. Isolation of vitamines is a particularly important study for there are a number of cases where cheaper foods could be made entirely satisfactory if we knew of some way to add, concentrated, the particular vitamine which it lacks.

In the proceedings of the National Academy of Sciences experiments upon the chemical isolation of vitamines are reported by Myers and Voegtlin. Working upon brewers's yeast, which is very rich in antineuretic vitamine, it was found that olive oil and oleic acid will remove the vitamine from the autolyzed yeast filtrate. The active material is readily extracted from dried yeast with acid methyl alcohol. The physiological action of the active fractions resembles that of extracts from the mucosa of the small intestine when the two extracts are purified in like manner.

## American Potash

FOR several years experiments have been conducted working toward the production of potash from the green sands of New Jersey. These sands are to be found in large quantities and contain about 7 or 8 per cent of potash. The Eastern Potash Corporation of New York is now constructing a plant designed to produce a thousand tons of potassium oxide annually. With this there will be residue estimated at 600,000 tons, which will be employed in manufacturing a silica lime type of brick. For this purpose the largest lime plant in the world is to be erected in conjunction with the potash plant. The equipment of the lime plant will consist of ten 8 x 125 feet rotary kilns producing a thousand tons of lime a day. The brick plant will have a capacity of 500,000 brick per day and this can be doubled if the demand justifies it. The project of winning potash from the green sands of New Jersey has been under consideration long enough to indicate that a sound foundation has been developed for this enterprise and the outcome will be watched with interest.

## Glycerine from Sugar

IN a recent issue of *Chemical Age* are to be found quotations from certain German technical papers to indicate that glycerine was produced upon a large scale from sugar in Germany beginning in 1915. Early in the war Germany had a considerable excess of sugar and the population was urged to use plenty of sugar on account of its food value. Later, however, on account of various uses found for sugar it became scarce and people found it difficult to follow the advice given earlier. The transformation of sugar into glycerine was accomplished by a biochemical method. It was known that with yeast, fermentation of sugar could be carried on in a way to convert 3 per cent of the sugar to glycerine; by the addition of various alkalies this percentage could be increased, and sodium sulfite was found to be the best material. As much as 36 per cent of the sugar was converted into glycerine. Acetaldehyde was also produced and was used for war purposes. The production of glycerine by this method exceeded 2,200,000 pounds a month and is a striking sample of the possibilities in the new fields opened through biochemical processes.

## Textile Misbranding

THE Federal Trade Commission recently ruled that seventeen concerns engaged in the manufacture and sale of underwear, shirts, and other wearing apparel must refrain from certain unfair methods of competition in commerce. The Commission's ruling made by agreement with the trade calls for more accurate branding of woolen goods and the firms named agree to refrain from using such brands as wool process, Scotch wool, Saxony wool, merino, or other descriptive brand to describe material not composed wholly of wool, unless the term describing the stock is coupled with the name of the other staples present in the fabric as, for example, worsted and cotton, or wool and cotton.

This is among the few rulings which have been made in the interest of textile branding. There are ordinances in several cities which if enforced would operate against the use of misinformation in advertisements, but these ordinances are seldom enforced. There is, however, one instance where the chemical laboratory was called upon to ascertain whether goods advertised by a merchant temporarily sojourning in a city conformed to the placards. The result was that the merchant moved on to other fields. The administration of laws designed to uphold recognized textile standards is difficult, but the time is certainly approaching when some way will be found.

## Concrete Tanks for Water Storage

TESTS on concrete tanks for water storage have been under way at the Bureau of Standards, where concrete of a mixture 1:2:4 were employed. After 150 days the day loss curves became a straight line indicating that the daily loss had become constant, and while the tanks showed some actual loss due to the penetration of the concrete by water they remained perfectly dry on the exterior. The head of water was 35 feet, but from the facts cited it would seem that this mixture when properly placed is waterproof to a satisfactory degree.

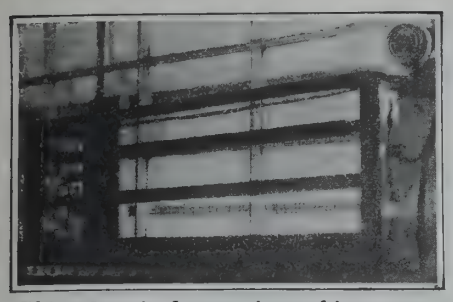
## Colloidal Fuel

NOTATION has previously been made in these columns of work done upon colloidal fuels by a number of chemists and chemical engineers. Since the processes devised under pressure of war emergency are applicable to various types of wastes, it would seem that colloidal fuels are sure to play an important rôle in the near future. If, as is claimed, such coal waste as culm, screenings, and dust can be used as well as peat, lignite, and sawdust, such a compounded fuel is indeed of unusual importance. Colloidal fuels are a combination of such fuels, particles of which are reduced to a size to make them colloidal, held in emulsion form by soap-like substances. When dispersed in fuel oil, tars, etc., can be held in suspense with sufficient permanence to permit storing, piping, and burning the mixture with the same facility as fuel oil itself. The subject is discussed by Jerome Alexander in the *Journal of Industrial Engineering Chemistry.*

## Water in Milk

A METHOD for detecting added water in milk has been devised by Dr. Hortvet of the Minnesota State Dairy and Food Commission. It is based on the constancy of the freezing point depression of milk observed by Beckmann in 1894. Milk has a constant freezing point due to a definite and constant relationship between the osmotic pressure of the blood and that of the secreted milk. Now, normal blood is constant in its osmotic pressure and milk must, therefore, also be constant. The freezing point of normal milk is its most constant factor, and while the osmotic pressure of milk would vary from the normal in under-nourished or diseased cows the marketed fluid is a mixture which is quite constant in this respect. It is not affected by the variable fat content nor the protein content and is the same for the first as for the last milk drawn, as well as for skimmed milk, separated cream, and the whole milk. The cryoscopic method distinguished between a normal milk of high water content and an artificially watered product.

The constancy of the freezing point has been established by many thousands of tests and the limits of depression have been found to be 0.54 degrees C. to 0.56 degrees C. The method has been found satisfactory to a minimum of 3 per cent of added water.



**This electric heater is nothing more than an old bed spring mounted on a wall**

## From Bed Spring to Electric Heater

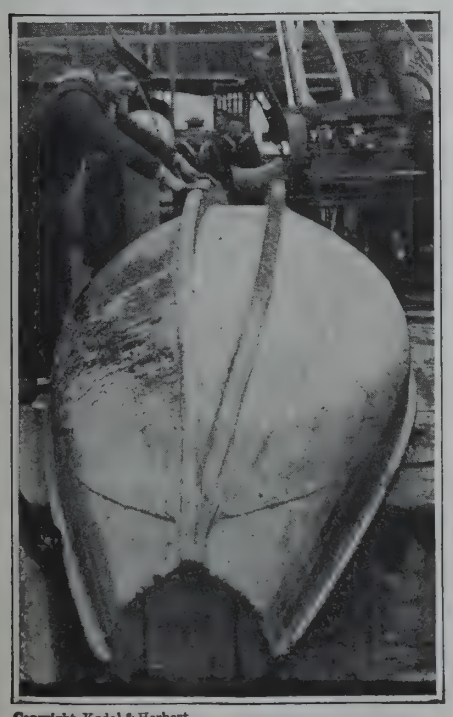
IN its crudest form an electric heater is little more than a mass of iron wire which heats up as electric current is passed through it. This thought must have made a deep impression on a certain youth of Glenn Falls, N. Y., who rigged up an old bed spring in the manner shown in the accompanying illustration, for the purpose of heating his room.

Current from a pair of 110-volt wires is passed through the entire bed spring, causing the iron wires to heat up. Obviously, such an improvised heater is by no means the last word in electrical efficiency, but as an ingenious makeshift it is really commendable. No data is available as to the current consumption of this unique electric heater, but it must run up into several kilowatts if an entire bed spring is utilized and the heat obtained is considerable. And as to whether it is efficient or not, depends largely upon who pays the electric bill!

## Putting Runners on the Arctic Lifeboat

WHEN the British ice-breaker "Sviatogor" left Rosyth, Scotland, bound for some point in the Kara Sea where a number of Russian men, women and children were ice-bound on board the steamer "Solovie," she had many of the earmarks of the usual polar expedition equipment. Among other things were the lifeboats equipped with double runners, one of which is shown in the accompanying illustration. These lifeboats serve in a dual capacity, namely, as lifeboats in the water and as roomy, if somewhat awkward, sleds over the ice-covered waters.

The "Sviatogor" is one of the two most powerful ice-breakers in the world. She was sent to the rescue of the "Solovie" in response to the wireless calls of distress.



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**Arctic lifeboat with a set of runners for traveling over ice fields**

## Music Lessons for the Canary

AN enterprising young woman has recently established a conservatory of music where canaries are taught how to sing sweetly. A corner of this odd establishment is presented in the accompanying view, showing the feathered pupils, the director, and an ingenious compressed air apparatus which produces the desired music for the birds.

Briefly, the singing course is simply a matter of blowing different whistles which the birds mimic more or less faithfully according to their training. These whistles are mounted at the top of the cylinder in the center of our picture, in a metal box which is provided with a hinged door. The top cylinder telescopes with the bottom cylinder, so as to form a pump. The top cylinder is raised by means of a counter-weighted cable and allowed slowly to settle down into the larger or lower cylinder . The air compressed in the cylinders is permitted to escape through one or more whistles, thus producing the desired sounds for training the birds in the nearby cages.

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**Teaching canaries how to sing with a compressed air battery of whistles**

## Paper, Paste and Ingenuity

WHILE we have been reading and hearing of the marvelous paper goods produced by Germans and Austrians ever since they became isolated during the World War, our own paper industry has been forging ahead along highly interesting lines.

Never before has there been such extensive use made of paper in one form or another. Certain manufacturers are turning out all kinds of paper goods from which numerous novelties can be produced. For decorative purposes certain manufacturers are producing so-called fire-proof crepe paper, which is a paper treated so as to burn quite slowly, removing the usual hazard connected with the use of paper. Papers finished to represent various kinds of wood are now used in making small frames.

The accompanying illustration represents a typical application of paper products. Here shown is a lady's hat made entirely of crepe paper, cardboard for the shape, and a few flowers or fruit of paper for the trimmings. True, such a hat is a short-lived novelty and will not stand rain; but is it any different with the usual lady's hat?

## New Coal Fields in Spitzbergen

THE director of the Swedish coal fields in Spitzbergen, Mr. Granholm, who has just returned to Stockholm, confirms the statement recently published in a local paper regarding newly discovered coal deposits on that island. It appears that these have been found at a depth of 26 feet below what has heretofore been considered as the bottom of the "Svea Mine." The vein recently opened, according to the director, has an average thickness of over 6 feet, with an estimated area of about 16,000,000 square feet. Up to the present none but expert miners have been employed at the "Svea Mine" in Spitzbergen, because of the difficulty in working the old 80-centimeter vein, but in the new vein unskilled labor may be utilized.

During the present year the output is expected to be 36,000 tons against 18,000 tons in 1919, while in 1921 the director estimates that at least 72,000 tons will be ready for shipment.

## A Fountain in a Bottle

A VERY curious little experiment may be carried out with a few simple materials. First of all fill a four-ounce bottle three-quarters full of water. Pierce the cork and insert a glass tube of small diameter. This tube must be long enough nearly to reach to the bottom of the bottle and project a little above the cork. Seal the cork airtight with sealing wax.

Now fold several sheets of wet blotting paper and stand the bottle on this. Next, get a large glass jar and hold this upside down over a lamp or a candle flame so that the air is well warmed. Then, still in an inverted position, press the jar over the bottle taking care that the edges are in close contact with the blotting paper so that the outer air is excluded.

In a few minutes the contraction of the air in the jar as it cools will cause a jet of water to rise up from the bottle. This will reach almost to the top of the jar and will be like a miniature fountain. If the glass tube is slender, so that only a little water passes at a time, the fountain will last quite a long while.

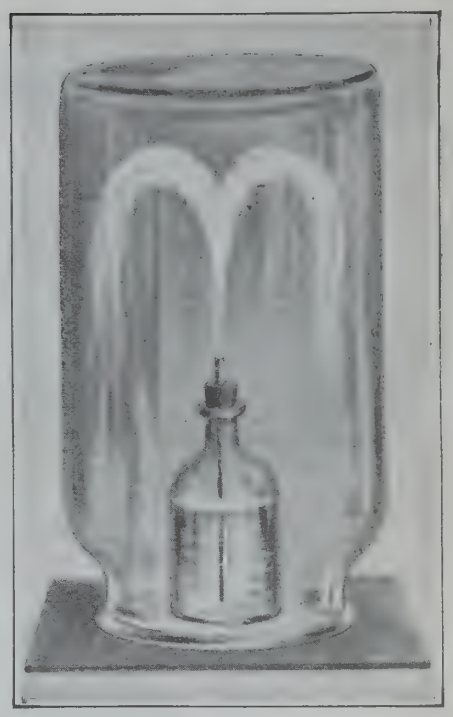
Copyright, Kadel & Herbert

**This paper hat costs 25 cents and lasts long enough to serve its purpose**

## The Vertical Camera and Its Uses

FOR the photographing of machinery parts, jewelry, books and other loose objects, the vertical camera is employed in most of the leading commercial studios. Such a camera forms the cover subject of this issue.

The vertical camera can be racked up or down so as to secure an image of any desired size; and the focusing is accomplished by racking the rear end of the camera up or down until a sharp image appears on the ground glass. Where small objects are to be photographed and absolute sharpness is necessary, it is not unusual for the photographer to make use of a ground glass sheet under the subjects. A light coming up through the ground glass on which the subjects rest facilitates the work of focusing the camera.



**A fountain produced in a bottle by simple means**

## Thawing Frozen Water Pipes by Electricity

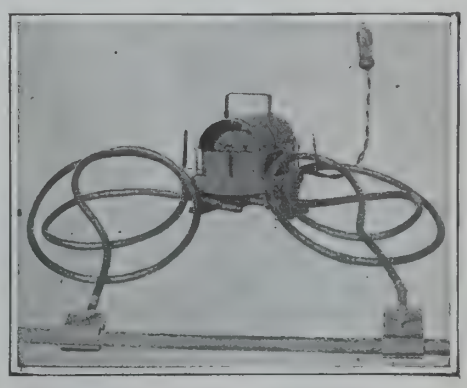
ONE of the latest developments in electrical convenience is the electric pipe thawer. Its function is to thaw frozen water pipes in a house electrically, a method which has considerable advantages over using a gasoline blow torch, or other ways attended by more or less fire hazard and inconvenience.

The device consists of a small transformer which can be connected to the house lighting circuit by means of a 10-foot lead and separable attachment plug which are provided. The two secondary cables, or those which are attached to the pipe to be thawed, are each seven and a half feet long and end in a cast brass clamp which can be used on pipes varying in diameter from one-half to one inch.

The purpose of the transformer is to reduce the lighting voltage to a point where a sufficient heat will be produced to thaw the pipes. This heat is produced by the resistance of the pipe itself to the flow of the current, and only about the same amount of energy is used as in running an electric flat iron.

In thawing out a pipe the nearest faucet should be turned on, and the secondary leads of the transformer connected to the pipe at a point nearest the entrance of the pipes from the street, the pipe being heated in sections until the water flows out of the faucet. The time required to thaw out a pipe depends on how long the frozen section is, the size of the pipe, and the degree to which it is frozen.

The whole apparatus is very compactly made, and easily portable, having a handle welded to the transformer case and weighing only 35 pounds complete.



**This electric thawing device thaws out frozen pipes in sections**

# The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

*This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles*

**This truck is a sprinkler in summer, an enclosed ash and garbage collector in winter**

## Double Service Municipal Truck

THE advantages of motor trucks for municipal use have been previously considered in these columns and many interesting examples of trucks have been illustrated. One of the drawbacks to the use of specialized equipment has been that in some cases it could not be profitably employed all of the year round. The accompanying illustration shows a double-service truck equipped with special bodies that are easily removed so that the same chassis can be employed for a number of distinct body types. For example, for summer service these chassis are fitted with large capacity tanks equipped with flusher and sprinkler attachments. During the winter season, when watering the streets would make traffic hazardous, even though it was thought necessary, the same chassis are converted into automatic dump trucks with enclosed steel sanitary garbage and ash-collection bodies.

At a time when increased facilities are needed for removing ashes, due to the universal use of heating equipment that is idle during the summer, the added motor equipment necessary is obtained by mounting relatively inexpensive bodies on the more costly chassis, which would otherwise remain idle if the design did not include the convertible feature. It was formerly necessary to lay up flushers and sprinklers during the winter months, this representing a considerable loss on the truck investment. The advantages of trucks adapted for the quick interchange of body equipment are apparent and attachment of special municipal adjuncts make an all-the-year truck investment. The machine illustrated is one of a large fleet of similar designs, used by the New York Street Cleaning Department.

## Trailers Reduce Cost

SLOWING down of business conditions and curtailment of credit in many lines have not affected the trailer industry much, according to reports of members of the Trailer Manufacturers' Association. There have been few cancellations and these have been offset by increased orders. The trailer people expect that as general business gets down to a more economical basis, manufacturers and merchants will look more closely to the cost of transportation and will adopt the trailer more generally as a sure means of reducing the cost of haulage and delivery. The increase in railroad freight rates is confidently expected to result in a larger development of the ship-by-truck movement. Shippers have already found that goods can be shipped more cheaply and quickly by motor truck than by rail for distances of fifty miles or more, and with an increase of 20 per cent in rail rates, there will be a still greater inducement to patronize the highway lines. The reason for the popularity of the tractor and trailer for nearly all hauling purposes can be very well understood by referring to the accompanying illustration which presents in a graphical manner the argument advanced by those favoring the use of trailers.

**A maker of automobile parts uses this trailer in his delivery to advantage**

## Trucks in Imperial Valley

THAT motor trucks are called upon to work under the most adverse conditions, but are meeting those conditions in a manner characteristic of an engineering achievement, is shown by fifteen motor trucks operating in the Imperial Valley, California, which is 119 feet below sea level with roads built of silt deposits from the Colorado River. It is situated about half way between Los Angeles and San Diego, and has a total population of 60,000 people who last year produced $66,000,000 worth of products. The water is all brought in by canals from the Colorado River. On account of the soil being silt, the roads are very bad and extremely dusty. It is the opinion of people living in California that there is no place in the United States where a motor truck is put through such unusual tests as in the valley.

During the summer months the temperature very seldom goes under 100 degrees a day or night and during the daytime the thermometer reaches from 130 to 135 degrees in the sun. For many months this fleet of fifteen motor trucks has been operating continually without interruption in the Imperial Valley hauling cantaloupes, watermelons, etc., from the fields to the packing pits and to the refrigerator cars under the most adverse conditions, not only in temperature, but in contending with traction difficulties due to the soft fields and sandy silt, hub deep, piling up in front of the wheels. An instance that shows climatic extremes with which these machines must contend is that of a 2½-ton power wagon loaded with watermelons weighing 8,500 pounds, starting from the valley 119 feet below sea level, making 70 miles of mountain grades after dark, reaching an altitude of 1,420 feet and then down to sea level again at San Diego.

## Truck Saves Money in Road Building

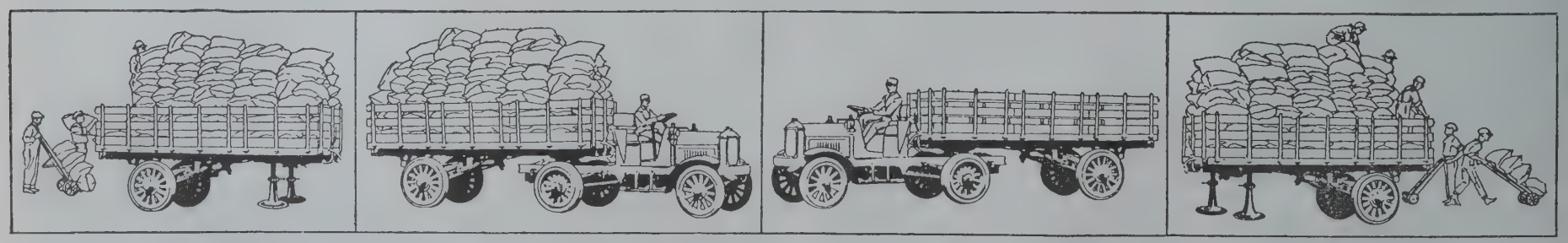
A THREE-AND-ONE-HALF-TON motor truck, equipped with a combination dump body, is doing state road work at Belgium, Wisconsin. It is said that this truck took the place of seven teams and saved the owner $33.25 per day. This road contractor, while doing State work, recently made some very interesting discoveries regarding the motor truck in road building. He was employing seven teams and fourteen men at the time the three-and-one-half-ton truck was received and set to work. The seven teams had each hauled three loads per day of one and one-half yards each, a total of thirty-one and one-half yards per day. By truck two men hauled thirty-three yards of crushed stone each day. Figuring the cost of each team and driver at $7.25 per day, the contractor was paying $50.75 per day for his seven teams. Assuming $17.50 per day for one motor truck, it will be seen that the motor truck saved him $33.25 per day.

It has been proved times without number that the motor truck will do as much work as six to eight horses and is much more economical to maintain and some users claim almost double that figure, the cost per day to operate four teams being in one case $29 and the cost per day to operate one truck $17.50. Here is a distinct saving of a trifle over forty per cent, and that is not all by any means.

**Motor truck with interchangeable dump and stake-bodies, used effectively on road work**

The all-steel dump body used was equipped with a special hoist. On two-ton bodies, 12-gage steel is used and on three-and-one-half and four-ton bodies 10-gage steel, while on all bodies the front end and tail gate are made of 8-gage steel. To preserve proper balance in dumping, all wide bodies of three and one-half tons have a special design worked out in the hook-up of the hoist to the body, which provides a front bearing for lifting of forty inches between centers. Consequently, an uneven load does not throw the cross strain into the body as does the usual narrow hook-up. For rock, sand and gravel, the four-and-one-half-ton truck has a length of 132 inches and a total width over the flare of 81 inches, the height being 16 inches, with a capacity of three and one-half cubic yards and a weight of nine thousand pounds.

The combination dump and stake body is sometimes used to combine the advantages of the all-steel dump body with those of the stake body, having dump- and stake-body sides interchangeable. The dump-body sides, and the stationary battlements which support the lifting arms, are constructed of rolled steel, reinforced with angles. The battlements, 24 inches high and 30 inches long, unite with the dump-body sides in forming an inside body compartment that can be dumped absolutely clean in twenty seconds. The tail gate for use with the steel body sides has its opening regulated to permit gravel, crushed rock, or other materials to be spread by the truck as it moves along. When not in use as a dump body, the steel sides and steel tail gate are instantly removable and side stake gates 36 inches high are substituted in their place, and a stake-body tail gate which hinges at bottom placed in position. A 10-inch and 14-inch wood reinforced tail gate, when lowered, extends platform length to a practical 10-, 12- and 13-foot stake body in the two-, three-and-one-half and four-tonners, respectively. The sub-frame is built of rolled steel channel and the floors are covered with 14-pound steel plates, fastened with bolts. The four-ton truck body for rock, sand and gravel has a length of 132 inches and a width of 80 inches, the height being 15 inches.



While one trailer (extreme left) is being loaded, the tractor is hauling a loaded trailer (left center) or returning with an empty trailer (right center), while all the time another trailer is being unloaded (extreme right) at the other end of the run

**A graphic argument setting forth the manner in which the trailer saves time and money by keeping the truck in constant motion**

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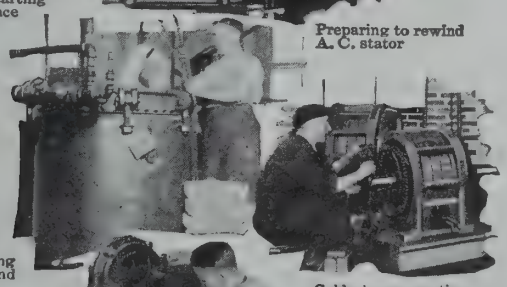
Adjusting A. C. rotor starting resistance

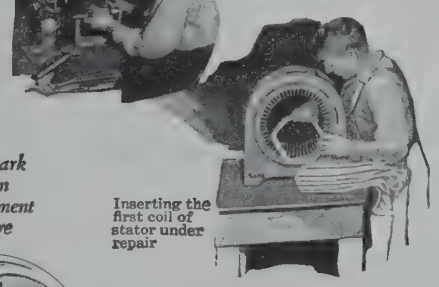
Preparing to rewind A. C. stator



Dipping coils in insulating compound

Soldering connections of rewound stator

Repairing fractional horsepower armatures



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Inserting the first coil of stator under repair

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# G-E motors

*From the Mightiest to the Tiniest*

45-103

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# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

## Of Interest to Farmers

GOPHER TRAP.—J. F. STANKIEWICZ, Bandon, Ore. An object of the invention is to provide an animal trap more especially for catching gophers, moles and other burrowing rodents. Another object is to provide a light metal trap which is strong in construction and which may catch two animals simultaneously, and that may catch the animal going into or out of the burrow.

TRACTOR.—E. E. LARSON, 651 S. Park Ave., Mason City, Iowa. The invention relates to tractors characterized by propelling members of the walking type. The tractor compresses rolling means supporting one end of the frame, endless tracks associate with the other end of the frame, a carriage on each of the tracks, a shoe associated with each of the carriages, and means associated with the shoe for accelerating the movement of the carriage when the shoe is moved from inoperative to operative position.

## Of General Interest

UMBRELLA AND PARASOL.—I. H. WEINBERG and C. F. BISBING, 23 E. 21st St., New York, N. Y. An object of the invention is to provide an attachment which operates to hold the ribs of the umbrella or parasol close to the handle and which also provides a convenient means for supporting the umbrella on the wrist or arm of the user. A further object is to provide an attachment which can be conveniently located on any ordinary umbrella or parasol and which will also be ornamental and attractive.

DATE STAMP LOCK.—A. MILLER, 70 Greenwood Ave., East Orange, N. J. Among the objects of the invention is to provide means for use in connection with conventional and standard type dating stamps for locking the type in alined printing position. It is also an object to provide a device which may be mounted upon the available space of the base plate of ordinary dating stamps, and which will compressibly engage the several type-carrying belts.

WEATHER STRIP.—C. J. JONES, 1319 Champa St., Denver, Colo. This invention has for its object to provide a weather strip for the meeting edges of window sash and frame, the meeting rails of the sash or the meeting faces of the door frame and door, which serve to keep out air and which form a snug juncture of the parts to prevent rattling. The device may be readily attached without skilled labor.

COLLAPSIBLE TUBE.—E. L. CLEVELAND, 941 Ainsworth Ave., Tacoma, Wash. The invention has reference more particularly to that class of tubes which are adapted to contain tooth paste and other plastic or semi-plastic materials and from which the contents are discharged by distorting the tube. The primary object is to provide means whereby a given quantity of the contents may be expelled without having the discharge continue after the pressure has been relieved.

COMPOUND CRAWLER.—E. RIMAILHO, 12 Rue de la Rochefoucauld, Paris, France. The object of this invention is to provide a compound crawler tractor with steerable propelling means which is particularly useful with gun carriages of heavy artillery, and for transporting and firing ordnance as well as for transporting loads of any kind, since it provides means for moving them on varying ground, while still allowing their travel on the road by their usual means.

BRUSH HANGER AND PAD REMOVER.—M. P. BENSON and M. M. WIENER, Monarch Brush Co., Troy, N. Y. Among the objects of the invention is to provide a hair brush comprising a rigid back with integral handle and a flexible removable pad carrying the bristles, the pad being removable for the purpose of cleansing, or other purposes, the specific object being to provide a means for ejecting the pad from the brush back.

CLAMP.—S. R. LIBBEY, Brady, Mont. The invention has for its object to provide a clamp especially adapted for use in connection with tubs to clamp a cover of flexible material over the tub without the use of nails, staples or the like. In practice a corrugated wire is used for providing resiliency in the event of expansion and contraction; the clamp is adapted to receive a seal.

DISPLAY STAND.—J. M. WALTERS, c/o J. W. Robinson Co., 7th and Grand Ave., Los Angeles, Cal. Among the objects of this invention is to provide a form of stand adapted for the display of evening gowns and lingerie, underwear and the like, wherein the fixture is so constructed that it will be hidden by the garment displayed. A series of attachments for each class of article to be displayed is provided for connection with the stand.

CAMERA.—C. G. JOHNSON, Eau Claire, Wis. The object of the invention is to provide mechanism in connection with folding cameras for permitting an exposure to be made on a lesser portion of the film than is usually exposed, provision being made for varying the size of the film desired for exposure, or permitting a picture to be taken the full size for which the camera was originally intended.

ALLOY.—V. P. TAYLOR, address 2.A. Dr. Bilisano, Dominguez, 42 Mexico D.4. Mexico. This invention relates to a metal compound, and aims to provide a product which will combine practically the lightness of aluminum with the strength of extremely hard metals. The alloy contains aluminum 80 to 100 parts, copper 8 to 17 parts. After the mixture has been melted small quantities of sodium tungstate, potassium, bichromate, and finely granulated cast iron are added.

DETACHABLE TOOTH.—C. A. CONOVER, Newburgh, N. Y. The invention relates particularly to a removable tooth, and has for an object to provide a construciton which will be mechanically effective for the purpose desired, and at the same time a construction which will present a pleasing appearance. The construction is capable of application to a bridge or crown, and may be applied at any time on the upper or lower jaw.

APPARATUS FOR EXTRACTING RESIN AND ALLIED PRODUCTS.—W. EDENBORN, c/o La. Railway & Navigation Co., 520 Hibernia Bank Bldg., New Orleans, La. Among the principal objects of the invention are to avoid retreatment of wood particles for the separation of resin previously extracted therefrom, to reduce the cost and simplify the method of extracting resin from wood particles, and to reduce the time factor for the extraction.

## Hardware and Tools

TOOL FOR ALINING AND FITTING MACHINE PARTS.—J. PEYER, 634 2nd St., Brooklyn, N. Y. Among the principal objects of the invention is to remove the necessity for performing the work for which the tool is designed under cramped or inverted positions, to insure greater accuracy in the work performed, and to correlate the various operations incident to alining and fitting machine parts. A broad purpose is to provide a tool to be used for fitting and realining the wrist pin bearings and connecting rod bearings in automobile engines.

DOOR LOCK.—E. E. L. MONTELIUS, 113 E. 75th St., New York, N. Y. This invention pertains more particularly to a door lock used in connection with a dumb-waiter shaft, which will render such doors incapable of being opened unless operated by a person in charge who would be in the basement of the building. A further object of the invention is to provide means associated with the lock which will prevent the unlocking of any doors other than those to the rear of which the dumb-waiter is positioned.

BUTTING TOOL.—R. W. AYLING, 427 17th St., West New York, N. J. The invention relates to tools used in temporarily bolting sheet-plates together, and has for an object the provision of a construction wherein the tool will coact with a wedge for causing a temporary bolt to be properly positioned when acting as clamping means for holding two sheets of plate together. A further object is to provide a tool which may be held manually.

WINDOW SCREEN CATCH.—J. B. BRADLEY, Box 1230, Miami, Fla. The invention relates generally to window screens, and more particularly to window screens which are hingedly connected adjacent to their upper side portions to swing at their lower portions toward and away from the sub-sill of the window frame; the object is the provision of a simple inexpensive catch fastening capable of ready adjustment and ready installation as well as durability.

## Heating and Lighting

OIL BURNER.—W. B. BOOKER, Freeport, Texas. This invention relates more particularly to a burner designed primarily for burning crude fuel oil, an object being to provide a construction which insures the centering of the oil discharge spray head within the burner head. A further object is to provide means for submitting the oil to the temperature of steam before reaching the burner so as to vaporize the oil and insure a perfect mixture with the steam for burning.

GUARD FOR GAS STOVE COCKS.—J. LAYDON, 268 19th St., Brooklyn, N. Y. The general object of the invention is to provide an attachment to be applied to a gas stove to prevent the accidental opening of the gas cocks by a person brushing past the same or the striking of the handle of the cock by another object. A further object is to provide a device which is simple and may be readily adjusted to close and guard those cocks not in use yet permitting any selected cock to be opened.

OVEN GRILL.—G. B. CASWELL, address Wm. Calhoun, Ast. E. & R. Officer, Fort Terry, N. Y. The object of this invention is to provide a grill fitting into the oven and adapted to support one or more food containers and arranged to permit the user to readily raise the containers from normal lowermost position to any desired height in the oven without danger of spilling the food, shaking it or otherwise handling it to detriment of the food.

## Machines and Mechanical Devices

TEXTILE FABRIC TREATING MACHINE.—L. CLARENBACH, 159 Hamilton Ave., Passaic, N. J. The invention relates to machines for treating textile fabrics in the open width with liquid, and has for its principal object to provide a machine in which the liquid is caused to thoroughly penetrate the fabric as it passes there through in a minimum time and uniformly, the fabric being forced against the liquid.

OPTICAL PRINTER.—H. B. BYRON, 359 E. 155th St., New York, N. Y. This invention has particular reference to photographing machines having a fixed optical center. Among the objects is to provide a negative holder having a plurality of light apertures adapted to be brought in succession into the axis of the light with facility and optical precision, whereby a more rapid or more perfect adjustment may be effected than would ordinarily be possible.

OIL ABSORBING DEVICE.—A. E. ALLEN, 25 72nd St., Brooklyn, N. Y. The invention relates to an oil absorbing device adapted to engage the needle bar of sewing machines to absorb any excess of oil which may accumulate on the needle bar. The primary object is to provide a device which may be easily applied and manufactured at a modest cost.

COMPENSATING APPARATUS FOR WELL DIGGING OUTFITS.—O. E. OAKES, Baxter Springs, Kas. A specific object of the invention is to provide a frame with reciprocally mounted spring-held pulleys to which a wire line is applied and which is so employed in connection with the drilling outfit that the springs are made to take up shocks and unusual strains in the drill cable to prevent breakage thereof.

PUMP.—W. R. TWIFORD, Manville, Wyoming. Among the objects of the invention is to provide a pump that is easy to operate, the column of water in the delivery pipe being counterbalanced by the pump plunger in a different pipe, to provide a pump in which the working parts are subjected to the least amount of wear, and being so designed that sand or other solid particles that may pass upward from the well with the water will never come in contact with the working parts of the pump.

HANGER BLOCK.—P. A. FRIEL, 84 W. 6th St., Bayonne, N. J. This invention relates to mechanical connectors and has particular reference to means for attaching planks, beams, studding, or the like to concrete or composite girders, posts, walls, etc. Among the objects is to provide a connector or hanger block adapted to be secured or snubbed to the flange of an I-channel or T-beam during the construction of a composite building element such as a girder.

## Prime Movers and Their Accessories

PRESSURE REGULATOR.—L. LEBRAS, 219 W. 66th St., New York, N. Y. The invention relates more particularly to an automaitc controlling device for the pressure of air utilized in liquid fuel feeding devices, such as commonly employed for internal combustion engines in connection with aviation motors or other forms of motor-propelled vehicles. An object being to provide an apparatus which will insure the maintenance of a uniform pressure in the liquid fuel tank for feeding fuel to the carburetors.

INTERNAL COMBUSTION ENGINE.—G. B. GERAU, 1393 E. 82nd St., Cleveland, Ohio. An object of the invention is to provide a shuttle valve piston for an internal combustion engine, the arrangement being such that the necessary valve mechanism is embodied in the piston and operated from the crosshead of the connecting rod, thereby eliminating a considerable portion of the weight of the engine ordinarily represented by the cam shafts, lift rods, etc.

BREATHER FOR GAS ENGINES. — A. PAJALIC, Dearborn, Mich. An important object of the invention is to provide a breather, which will serve to allow free escape of compression from the crank case, and will serve to separate and return to the crank case any entrained oil or the like. Another object is to provide for the exclusion of dust or other foreign substances from the crank case and for allowing for the admission of air.

## Pertaining to Recreation

TOY AIRPLANE.—A. Z. BAKER, 301 Washington St., Newark, N. J. A general purpose of the invention is to provide a toy airplane of the knock-down or dismantled type in order that it may be packed for the market in comparatively small cartons to facilitate transportation and distribution. A further purpose is to provide a toy airplane assembling the wings, to eliminate the use of permanent structural means such as screws, nails or tacks.

## Pertaining to Vehicles

AUTOMOBILE BODY CONSTRUCTION.—J. J. JONES, 145 S. Hillside, Wichita, Kan. The invention relates more particularly to small light vehicles including four-wheeled frames, but which are known as cycle cars. This type of vehicle is distinguished for its minimum air resistance, its light weight, its low center of gravity increasing its tractive qualities, but is ordinarily limited to two passengers. The object of the invention is to provide a body construction which will permit of the seating of four passengers comfortably without great increase of weight.

LUBRICATING MEANS FOR LEAF SPRINGS.—H. RIGBY, 899 E. 19th St., Paterson, N. J. The object of the invention is to provide means for lubricating leaf springs of automobiles and other vehicles and devices arranged to permit the use of standard parts thereby reducing the cost of manufacture to a minimum and to permit convenient replacement of the parts, if necessary.

AUTOMOBILE LOCK.—J. W. HUNTER and E. WILLIAMSON, Mobile, Ala. An object of the invention is to provide a lock or holding device for automobiles, which will prevent turning movement of the steering wheel and which can be readily moved out of the way when not in locking position, and securely locked when in position to hold the wheel, and prevent steering by any one except the rightful owner.

TRANSMISSION CASE.—G. H. PADGETT, Pinecastle, Orange County, Fla. The aim of this invention is to provide a case construction in such manner that it will be possible for access to be had to the transmission without the destruction of the oil-proof gaskets and with which the entire operation may be completed by one man in a fraction of the time usually required by two; furthermore it is not necessary with this device for the operator to be under the car.

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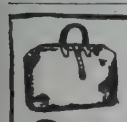

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## Something Different in Salvaging Operations

(*Continued from page 518*)

lower end, designed to engage the bottom edge of the trunks and to discharge into the water surrounding these structures. In fact, the ease with which the crook-like pipes could be got into place from the surface and the certainty with which the air could then be controlled from the salvage craft made them the principal aid by which the buoyant medium was manipulated during the refloating of the "Canadian Recruit." It should be understood that the under-water plating of the hull abaft the engineroom was intact and necessitated no repairs in the region where compressed air was applied. Forward of the after bulkhead in the engineroom, however, divers had to patch the injured shell. With that done, the unwatering of that section of the steamer resolved itself into a simple job of pumping, for the deck and hatches throughout that stretch to the bow were above the surface of the river.

By reference to Fig. 3 it will be seen that the stern of the steamer rose to the surface when sufficient air had been forced into the cargo space; and it will be observed that the level of the water in the trunk coincided with that of the surface of the river. In Fig. 4, however, the moment before the vessel righted herself and ceased to rise higher, it will be noticed that the level of the water in the trunk was below that of the river and yet higher than the surface of the water generally in the hold. This plainly indicates the thrust of the confined air and the manner in which the movement of the column of water in the trunk served to relieve the bursting pressure of the compressed air. A few moments later the air was free to escape upward into the trunk, and the superposed water was blown into bubbles and spray like a sizzling bottle of soda.

This new salvage device, so simple in its get-up and comparatively easy to instal, furnishes at once a ready solution of many of the vexing questions involved in raising a deeply sunken ship by recourse to compressed air applied internally. Where the circumstances permit its employment it does away with the need of ordinary compensating apparatus, because each trunk becomes in effect a great automatic relief valve that can be depended upon to function correctly as the enveloping hydrostatic conditions alter. It was just the absence of any prompt and ample means for taking care of the expanding air, as the ship rose, which frustrated one of the initial stages of the refloating of the U. S. S. "Yankee."

Active work on the "Canadian Recruit" was started on the 16th of May of the present year, and she was floated clear of the shoals fifty days later, forty days of that interval having been taken up in removing cargo. Ten minutes after air was turned into the after hold her stern rose clear above the tide.

## A New Magnesium Alloy for Motor Pistons

(*Continued from page 519*)

Where this metal is re-worked or rolled, drawn, drop forged or heat treated, the tensile strength is increased at each operation. In heat treating, sand castings are increased from 22,000 up to 30,000 pounds, without causing any appreciable change in the yield point, while the elongation and reduction in area are increased 6 per cent. In drop forging, the tensile strength is increased to 50,000 pounds and the Brinell hardness rises to 70 or better.

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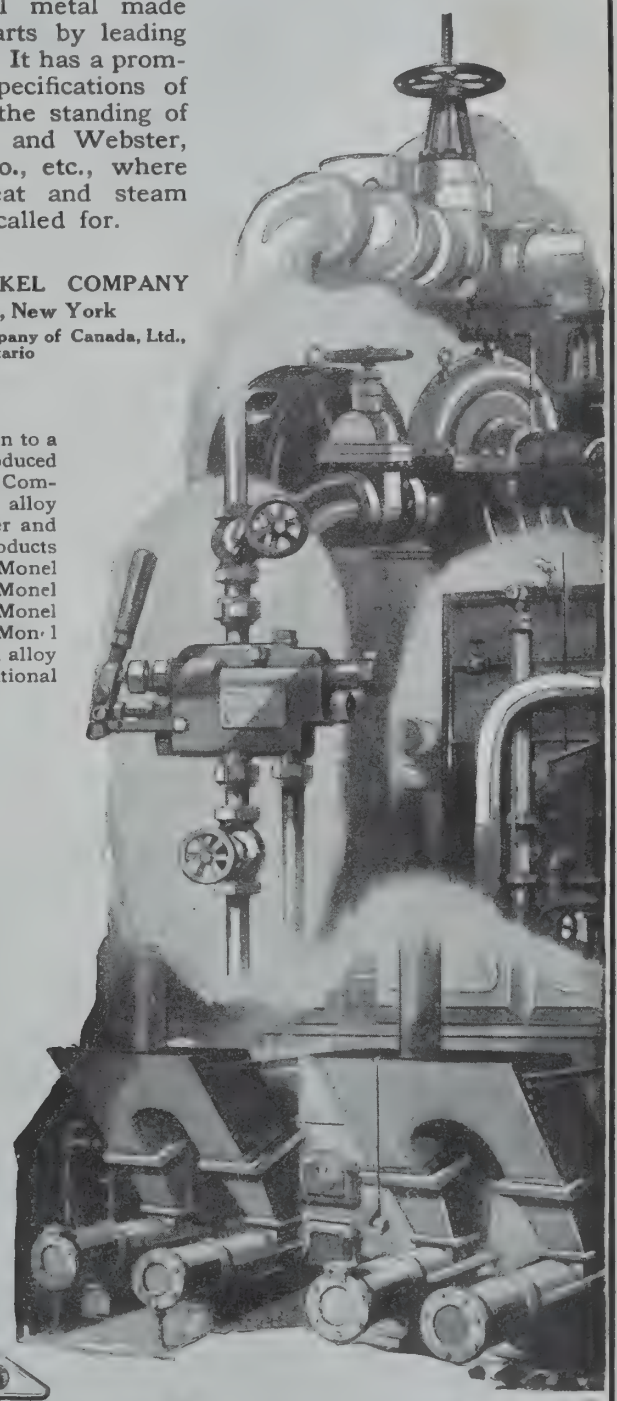

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sion of the test, the piston showed very little wear and the cylinder none.

A recent test in a plant of a well-known manufacturer of motors showed that these motors developed six horse-power more with the new metal pistons than they had ever developed before with any other material. In spite of the rather ample clearances with which these pistons are installed in the cylinder, no case of oil pumping has yet been recorded and the objectionable piston slap is absent. The possible applications in the automobile and in airplanes are apparent to the automotive engineer.

## A Giant Ingot Mold Casting in the Making

(*Continued from page 519*)

Owing to the height of the casting, and the consequent high head of liquid metal, it can readily be seen that the pressure at the bottom of the mold would be a serious factor in pouring this casting; in fact, the pressure at the bottom would be so great that there would be a tendency to crush the core and force the walls of the mold inward, thereby reducing the diameter of the casting at this point. One of the problems, therefore, was to construct the core so that it would be sufficiently strong to withstand this crushing tendency and at the same time be sufficiently pliant so that it would yield to the shrinking process which takes place as the casting cools. It should be sufficiently porous to allow the escape of the gases that are generated in the core through contact with the heat of the molten metal. As the rate of shrinkage in the diameters at the bottom of the mold would be different from that at the top, it was, of course, necessary to regulate the diameters of the core and mold at the top and bottom to such a degree of nicety that when completely cooled and all shrinkage had ceased, the resultant diameters would be alike at both ends of the casting. One of the illustrations shows the special core being lowered into the mold in the ground. The weight of the finished casting was approximately 114 tons, but to pour it there was provided a total quantity of 135 tons, the excess representing gates, runners and the riser which was cast on the mold as mentioned. In order to have this large quantity of metal ready for pouring at one time, it was necessary to make special provision for storing a large portion of it. This was done by building adjacent to the mold a large reservoir with a capacity of 70 tons. This reservoir was made up of cast iron pigs and properly lined with fire brick and clay to hold the molten metal. In addition there were three ladles of molten metal holding respectively 25, 30 and 10 tons. The 70-ton reservoir was connected to the mold by means of a trough, and at the proper moment the plug at the bottom of the reservoir was withdrawn and the molten metal released and conveyed to the mold through the trough. At the same time the ladles were poured into the mold through other similar runners.

## Aircraft of the Future

(*Continued from page 520*)

small variations in altitude as are the planes of today, for the whole use of the air as a means of transportation means the use of all levels where life can be sustained, and the running of passenger and freight planes where they will meet the least resistance and consequently operate with the greatest economy.

The problem of the air-screw (propeller) receives a great deal of attention at the hands of the committee. They summarize the outstanding problem as one involving the construction of a screw with blades adjustable in pitch. The problem is twofold, involving (1) determination of its aerodynamic proportions and pitch so that under widely varying conditions of flight at varying altitudes, varying speeds and varying degrees of climbing, the screw may present always the most satisfactory curvatures to accomplish the desired end with the available power; and (2) the construction of such a screw.

The determination of the theoretical proportions is a problem well in hand. The making of such a propeller which shall properly function has not yet been achieved. So it is proper material for a prophecy to the effect that the airplane of the future will have adjustable propellers capable of combining with its variable wing-surface and camber to produce variations of speed, lift and revolution-per-minute, to the end that a plane be able to function most effectively at many speeds and altitudes with the minimum of power and weight.

The committee finds that the greatest problem of all is the "best economic utilization of the enormous investment which has been made in aeronautical production, expressed in terms of money and human time and energy."

Basing, then, the final prophecy upon the final problem, it seems inevitable to state that the plane of the future will have at least as great a part to play as steam transportation has had in the development of civilization. That the airplane will eventually make war impossible because too destructive of civilian life is the hope of those who see universal peace not as a vision but as a practical possibility. That the airplane will eliminate time and distance in a wholly new sense is already assured. That it can only do so commercially by being made entirely safe and wholly economic is obvious. That the path to these desired fields lie through the speedy solution of mechanical problems here outlined hardly needs demonstration—that this "prophecy" of what the plane of the future must be is based upon concrete facts and not at all upon fancy is its only excuse for being.

## Our Coal in the Making

(*Continued from page 522*)

ward speed of the tractor-like machine is such that enough raw material is excavated, macerated and dried to prepare from 5 to 10 tons of dry fuel for each working hour. The machine may be operated by gas or electric motor, but about 50 horse-power is required. One man operates the machine. The cost of peat fuel, so prepared, Mr. Garnett estimates at about $2.25 per ton at the swamp.

During the process of maceration a glue-like substance held in the plant cells is liberated and this acts as a cement for holding the briquets together and as a waterproofing agent. It will be noted that the raw peat is placed on the ground, which is, first, the easiest place to put it; and, second, has the advantage of keeping the under side of the bricks moist, permitting the moisture to be driven upward by contraction of the bricks. Bricks dried in racks often crack to pieces due to rapid surface drying. After the bricks are dried they are taken up by hand and then are run through a crusher and delivered to the consumer for hand firing, the same as crushed coke, the size being determined by local requirements.

A Minneapolis company has made extensive experiments in the preparation of a pulverized fuel from this peat and they have obtained surprising results in firing pulverized peat in competition with pulverized coal.

Tests recently run in a big office building in Minneapolis showed that the evaporation per pound of coal was only ten per cent higher than per pound of peat. This appears to contradict the fact that the B.t.u. value of the peat was only about two-thirds that of the coal. But credit is not given in the B.t.u. test for the fact that the peat contains very little carbon and burns with almost no ash, and in addition contains oxygen of its own, which the coal must obtain from the air. This latter is a very important consideration,

(*Continued on page 534*)

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## Our Coal in the Making

*(Continued from page 532)*

for in obtaining oxygen from the air a very large amount of inert gases must be heated to combustion heat and these do no work. The peat is burned with the dampers almost closed, using only about one-half the air required to sustain combustion in the coal.

Burner equipment, it is claimed, for pulverized peat costs only about 80 per cent of the value of automatic stoker equipment, maintenance costs are about 60 per cent less, and the fuel delivered under the boiler costs less than $5 a ton. If these facts are borne out in practice, it is clear that there is a large and immediate field for such fuel.

About one-seventh of the total peat lands in the United States are located in Michigan and experiments being conducted at Chelsea, Mich., by G. A. Willmarth, a peat engineer, are scarcely less interesting than those going on at Minneapolis. Mr. Willmarth has turned his attention to the production of coke from peat and has succeeded in making a product of commercial value, which can be used to replace the expensive charcoal made from hardwood, and in making a peat fuel with a heat value claimed to be over 13,000 B.t.u., surpassing bituminous coal and equaling anthracite in heat value.

In this process only a part of the peat is artificially dried and this is turned into coke and ground with the raw peat. This serves to break up the water cells. The mixture is molded into briquets by a special machine and these are air-dried in sheds. The process, briefly, is as follows:

A coking retort is filled with air-dried peat and fire started in the usual way. Then, as raw peat is taken from the bog, it is first run through a disintegrator, a heavy machine that has two rolls, 12 by 22 inches, with tool-steel cutting bars extending from the rolls and running at speeds of 100 and 900 revolutions, respectively. As the peat passes between these rolls it is at once crushed and cut up, together with all foreign substances.

Then it is elevated to a hopper over the "pug mill," which cuts and grinds the peat to a loose granular form. Thence it is sent to a dryer, specially designed for the purpose. It is a drum 3 feet in diameter and 12 feet long, having parallel strips on the inside for lifting the peat as the drum revolves and dropping it upon adjustable slotted disks. Waste heat is drawn from the retort, together with the hot gases from the gas engine and these are forced through the drum by a fan and pass off out the smokestack. The peat, when it reaches an air-dried condition is discharged to the hopper above the retort.

After the retort is filled and the fire started, the gas and tar rapidly pass off to a purifier and scrubber. The scrubber is an upright tank, partly filled with coke, which is sprayed continuously with water. The gases are drawn upward through the coke and the tar is removed by the spray, the gases being forced into a gas holder by a centrifugal pump.

The retort holds 72 cubic feet or 1,440 pounds of air-dried peat, and this will make 8,500 cubic feet of gas, 10½ gallons of tar, and 650 pounds of coke, or 800 pounds of half-coke. The gas is used for power purposes, heating, etc.

The coke, which is then about one-half the weight of the peat used, is elevated to a hopper in which raw peat, which has been disintegrated, is also placed. After being thoroughly mixed and ground in the pug mill, it is sent to the smooth roll grinder, which is a heavy machine having two adjustable steel rollers, 12 by 22 inches, running at different speeds, so that the coke is crushed with the peat.

Here is really the secret of the whole process. When the granules of the coke are crushed with the raw peat, the minute water cells are broken. The plas-

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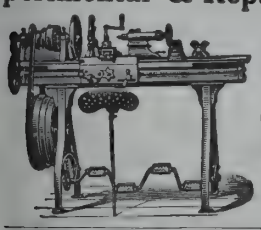

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tic mass is then pressed into bricks on a special machine and these are conveyed to sheds, where they dry very quickly. Used for heating purposes exactly as coal would be used this fuel is said by persons who have used it to be a superior product. It is easily kindled, burns freely and gives an intense heat. If the drafts are closed it will keep fire for a long time and when the drafts are opened a good fire will be had almost immediately. It is cleaner than coal and more easily managed. There is very little smoke and no soot and it leaves no clinkers, only a soft light ash.

Some fifteen years ago a number of highly ingenious but useless machines were designed and built in this country for the manufacture of peat briquets. The inventors failed, however, to take into consideration the nature of the raw peat and without exception their product was a commercial failure. The public was induced to invest thousands of dollars in these enterprises and undoubtedly this experience has had a great deal to do with the lack of progress here in recent years.

### Taming the River Nile

(*Continued from page 524*)

storage, the Blue Nile to irrigate Soudan, sounds easy enough, but political considerations immediately came into the picture. The government of the Soudan is double-headed. The country is called a condominion because it is part Egyptian, part English. It flies both flags. England had to have a hand in it after the affair which culminated with the loss of Gordon at Khartoum, and she made the country partly English by force of arms. All its officials are English. But the Soudan is not Egypt and Egyptians stood aghast at the proposition to dam the sources of the Egyptian Nile proper. The Blue and White Nile dams were threats to throttle the very life of Egypt before ever it got to Egypt. Moreover, Col. M. R. Kennedy, Chief of Public Works of the Soudan, expressed a belief there was not enough water for all the proposed dams and irrigation, and that the end would be a robbery of Egypt.

Nevertheless, war knows no pity and little equity. England could not wait and passed a bill, gave Soudan the money and the Blue Nile dam was begun to supply water for cotton to be farmed by an English syndicate.

There was a politico-irrigation cyclone immediately. Willcocks and Kennedy made charges, even criminal charges, against MacDonald, saying among other things that he had falsified water records to get the bill through, and the Fellaheen of Egypt, who knew little of politics but much of water and dams and irrigation, stirred up such a row that to settle matters, commissions were appointed to investigate, three of them in succession. The first two were neither listened to nor honored—the first because only bureaucrats were members, the second because the decision was against Egypt. To still the noise, England appointed a third commission.

Egypt and her Fellaheen had protested so loudly against unfair commissions that this commission was to be unprotestable. And Egypt and the Fellaheen had heard both of American irrigation, of American engineers and their startling ingenuity, and Egypt and the Fellaheen believed in the land of the square deal and fair play. So England invited America's leading irrigation expert to form the third member of the Nile Commission, and Mr. H. T. Cory, the "boss of the Colorado River," who made the Imperial Valley the "Egypt of America," became the third member.

The Nile Commission met in Cairo in February of this year and under Judge Booth in a mixed court in Cairo took sworn testimony for four weeks as to the charges against Sir Murdoch MacDonald and finished with going over the project physically as well as by plans and testi-

# Tobacco Teeth
## See the change in ten days

Smokers' teeth discolor more than others, usually. But the stains lie in a film, and removing that film removes them.

There is now a way to combat this film. Millions of people employ it. Leading dentists everywhere advise it. See how teeth whiten when you use it a few days.

### Film ruins teeth

That film on teeth which makes them dingy causes most tooth troubles. It is viscous—you can feel it. It clings to teeth, enters crevices and stays.

The old ways of brushing did not end it, so millions found that well-brushed teeth discolored and decayed.

It is the film-coat that discolors, not the teeth. Film is the basis of tartar. It holds food substance which ferments and forms acid. It holds the acid in contact with the teeth to cause decay.

Millions of germs breed in it. They, with tartar, are the chief cause of pyorrhea. Very few people have escaped these troubles caused by film.

### Now we combat it

Now dental science has evolved ways to combat film day by day. Able authorities have amply proved their efficiency.

These methods are combined in a dentifrice called Pepsodent. Millions have adopted it, largely through dental advice. It opens, we believe, a new dental era. And, to let all know it, a 10-Day Tube is being sent to everyone who asks.

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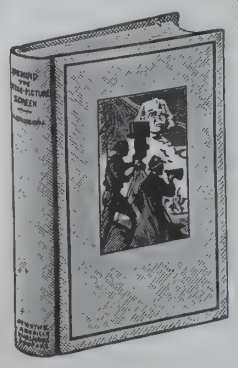

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mony. The charges against MacDonald were found to be without basis; it was ascertained there was water enough for all, and, on a strictly engineering basis, the projects were recommended to go forward to completion.

Briefly, these huge engineering works include two dams (now under construction) a storage on the Blue Nile of nine million acre-feet of water, and a canal, to abort the swamp in the Sudd region which now absorbs the greater part of the White Nile flow. The White Nile has its rise in Lakes Albert and Victoria, and if the swamp loss is cut off the storage in these lakes will be vastly increased. But the canal will be 225 miles long and twice the excavation yardage of the Panama Canal. When finished the whole project will conserve eighty per cent of the mean annual flow of the Nile, will cost fifty million Egyptian pounds ($250,000,000), will irrigate 10,000,000 acres (double the present acreage), and put five million acres in cotton. As a measure of comparison let it be said that in the United States we irrigate 32,500,000 acres.

## Keeping Tabs on Bird Peculiarities

(*Continued from page 525*)

only when a bad storm indicates the permanent approach of colder weather. Bird banding work has been under headway for some time in England, Germany and Denmark so that the data from abroad, in many instances, will be available to check the findings ascertained in this country.

By the location of feeding and registering stations along the migratory routes, the government authorities hope to obtain interesting data concerning the speed of migration as well as the affinity of birds for certain nest sites. For many years people interested in bird life have contended that the same birds returned to the same nest each year. If this is true it indicates that a pair of birds will mate for life. Uncle Sam is anxious to ascertain definite facts in this regard. Considerable is known about the habits of the different species of land birds but little is on official record relative to the characteristics of the individual birds of the different families. For example, the class characteristic of the cardinal is to fight and squeal when first captured. However, several cardinals have been snared by representatives of the Biological Survey which displayed neither of these qualities but which were extremely docile and tractable as soon as they were captured.

Some birds acquire full plumage in a single year. Others, like the oriole, take several years to develop their permanent overcoats of feathers. A certain variety of the heron family which breeds commonly in the southern swamps in juvenile plumage is always white, while in adult garb its dress changes to blue. Peculiarly enough, some of the birds of this species at the age of about one year display what is known as calico plumage—a mottled kind of white dress. It is only through a comprehensive and continuous campaign of banding and registering the birds in all sections of the country, such as that to be inaugurated by the Federal Government, that complete and definite data concerning the why, when, where and how of bird doings will be collected and correctly interpreted.

Mr. S. Prentiss Baldwin of Cleveland, Ohio, and Thomasville, Georgia, has conducted some of the most important bird-banding and systematic trapping investigations attempted in the United States. He reports that of over 5,000 or more birds which he has handled during the last five years not more than five have been seriously injured in the traps. His experiences indicate conclusively that the birds are, in no respect, harmed by the trapping and banding and that really the handling helps to tame the birds. The greatest source of damage to the captive birds are cats and that is why it is necessary to surround each trap with a guard fence which will prohibit these felines reaching the cages and worrying the birds.

The bird student who desires to essay bird feeding, banding and registering should first of all carefully scrutinize the game and bird laws of his State and ascertain positively from the local authorities whether the temporary catching of the birds for banding and registering constitutes a technical violation of the State laws. If necessary, it may be advisable for the enthusiast to secure a collector's permit in States where the local legislation is opposed to bird trapping. In the main, the feeding and protection accorded the birds by the people interested in studying their intimate habits and peculiarities completely overbalance any of the very rare injuries which result as a consequence of the fliers being held for short periods in captivity.

## How Meadow Mice Destroy Trees

(*Continued from page 525*)

In the maple collection nearby at least two trees have been destroyed, and four Japanese maples in the Fruticetum have been girdled. In the case of one of the latter many of the lower limbs were covered with snow and these were entirely stripped of their bark. In the hawthorn collection, also, several trees have suffered in this way, but none appear to have been girdled.

Two lindens, one poplar, several wild cherries, and other trees scattered about the grounds have likewise suffered, but not to the same extent as the shrubs.

In the lilac collection recently installed on Pelham Parkway, containing many fine French varieties, between thirty and forty plants have been destroyed. In the weigela group north of the lake near the museum building twelve of the large clusters have been completely girdled; while at the Mosholu Approach and elsewhere, the weigelas have suffered severely.

The Georgia syringa collection is planted in a low spot in the Fruticetum, where there is much grass and the snow lingered long. Here the mice camped among the stems a foot or more above the ground and played havoc with nearly every one of them, eight large clumps being destroyed. The oriental sweet shrub on the bank above seemed to be especially attractive to the mice, eight of these clusters having been destroyed.

A group of deciduous holly was wiped out, shrubs of the pea family, privets, willows—almost anything within reach seemed acceptable to this small, lurking enemy, which is so difficult to combat. Nor was the loss confined to one locality. Reports from other sections indicate that the destruction by meadow mice last winter was much worse than ever before recorded. Toward the end of April I had an opportunity to see some of this destruction in the orchards about Yama Farms in Ulster County, New York. In one orchard visited, containing several hundred apple trees just coming into good bearing, not a single tree was spared. All of them were girdled clean for a space of from one to two feet above the ground.

Bridge grafting is often recommended to save trees not entirely girdled. Strips of fresh tissue are inserted during April, when growth is actively beginning and before the wounds have dried out, and the descent of food to the roots is thus insured. A tree wounded near the base, however, is always liable to attack by fungi, this being a very vulnerable point.

On May 6 I visited the grounds of the International Garden Club in Pelham Bay Park and saw beautiful climbing rose bushes trained against a wall, gnawed clean by mice for a distance of three feet above the ground; and in a group of about thirty Japanese maples, twenty-one were girdled beyond hope of recovery. In a field near by, black locust trees over a foot in diameter were completely girdled although the inner bark of this tree is considered poisonous to horses.

IN THIS ISSUE:

MAKING THE BARGE CANAL PAY
ONE HUNDRED YEARS OF GAS LIGHTING

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

DETECTING AND LOCATING AUTOMOBILE ENGINE TROUBLES WITH THE STETHOSCOPE.—[See page 545]

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# from GUESSWORK to a SCIENCE

***How the Chart established America's Supremacy in Scientific Automobile Lubrication***

"EVERY great scientific truth," said Agassiz, "goes through three stages. First, people say it conflicts with the Bible. Next, they say it has been discovered before. Lastly, they say they have always believed it."

You may not realize that scientific automobile lubrication has passed through three somewhat similar stages—indifference—passive acceptance—active endorsement.

Fifteen years ago the Vacuum Oil Company organized its study of motor car lubrication. We were the first to take up in a scientific manner the lubricating problems of all makes of motor cars.

As a result of careful analysis and experiment there was formulated the first Chart of Recommendations ever made for automobile engine lubrication. Although there were then only about 125,000 motor cars on the roads, the Vacuum Oil Company foresaw the immense possibilities of the automobile. They felt keenly that more might be properly demanded of an oil than "that it kept the car running all right."

By the fall of 1906, the first Chart was complete. In January, 1907,the Chart was ready—in booklet form—for general distribution.

The Chart in two respects was revolutionary. It specified different grades of oil for different cars. In some cases it specified a different grade of oil for winter use than that recommended for summer.

In its early history the Vacuum Oil Company Chart of Automobile Recommendations did not escape belittlement. But by the sheer soundness of the scientific principles advanced, and by the sheer quality of the grades of Gargoyle Mobiloils provided, the outcome was never uncertain.

## Chart of Recommendations *for* AUTOMOBILES

(Abbreviated Edition)

### How to Read the Chart

THE Correct Grades of Gargoyle Mobiloils for engine lubrication are specified in the Chart below.

A means Gargoyle Mobiloil "A"
B means Gargoyle Mobiloil "B"
E means Gargoyle Mobiloil "E"
Arc means Gargoyle Mobiloil Arctic

These recommendations cover all models of both passenger and commercial vehicles unless otherwise specified.

| NAMES OF AUTOMOBILES AND MOTOR TRUCKS | 1920 | | 1919 | | 1918 | | 1917 | | 1916 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter | Summer | Winter |
| Allen | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Atlas | A | Arc. | A | Arc. | A | Arc. | A | Arc. | ... | ... |
| Bessemer | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Biddle | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Buick | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Cadillac | A | A | A | A | A | A | A | A | A | A |
| Chalmers (6-48) | ... | ... | ... | ... | ... | ... | ... | ... | Arc. | Arc. |
| " (6-40) | ... | ... | ... | ... | ... | ... | ... | ... | A | Arc. |
| " All Other Models | A | A | A | A | A | A | A | A | A | A |
| Chandler Six | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Chevrolet (8 cylinder) | ... | ... | A | A | A | A | A | A | ... | ... |
| " (FA) | ... | ... | A | Arc. | A | Arc. | ... | ... | ... | ... |
| " (FB & 1 ton) | A | Arc. | ... | ... | ... | ... | ... | ... | ... | ... |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Cleveland | A | Arc. | ... | ... | ... | ... | ... | ... | ... | ... |
| Cunningham | A | A | A | A | A | A | A | A | A | A |
| Dixie Flyer | A | Arc. | A | Arc. | A | Arc. | A | Arc. | ... | ... |
| Dodge Brothers | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Essex | A | Arc. | A | Arc. | ... | ... | ... | ... | ... | ... |
| Federal (Model S-X) | ... | ... | ... | ... | A | A | A | A | ... | ... |
| " (Special) | ... | ... | ... | ... | Arc. | Arc. | ... | ... | ... | ... |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | A | A | Arc. | Arc. | Arc. | Arc. |
| Ford | E | E | E | E | E | E | E | E | E | E |
| Franklin | A | A | A | A | A | A | A | A | A | A |
| G. M. C. Trucks | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | Arc. | Arc. |
| Grant (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (Com.) (Model 12) | ... | ... | A | Arc. | ... | ... | ... | ... | ... | ... |
| " ( " ) All Other Models | Arc. | Arc. | Arc. | Arc. | ... | ... | ... | ... | ... | ... |
| Haynes (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (12 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Holmes | B | A | ... | ... | ... | ... | ... | ... | ... | ... |
| Hudson Super Six | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | A |
| " All Other Models | ... | ... | ... | ... | ... | ... | ... | ... | Arc. | Arc. |
| Hupmobile | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Jones | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. |
| Jordan | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... |
| King (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Kissel Kar (Model 48) | ... | ... | ... | ... | ... | ... | ... | ... | A | A |
| " (12 cylinder) | ... | ... | ... | ... | A | A | A | A | ... | ... |
| " " All Other Models | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Liberty | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... |
| Locomobile | A | E | A | E | A | E | E | E | E | E |
| Luverne | ... | ... | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. |
| Maccar (5½ ton) | A | A | A | A | A | A | Arc. | Arc. | ... | ... |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Marmon | A | A | A | A | A | A | A | A | A | A |
| Maxwell | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Mercer | A | A | A | A | A | A | A | A | A | A |
| Mitchell (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (8 cylinder) | ... | ... | ... | ... | ... | ... | ... | ... | A | A |
| Moline-Knight | ... | ... | B | A | B | A | A | A | A | A |
| Monroe (Model M 2) | ... | ... | ... | ... | ... | ... | ... | ... | E | E |
| " ( " M 3) | ... | ... | ... | ... | A | Arc. | A | Arc. | ... | ... |
| " All Other Models | A | A | A | A | A | A | A | A | ... | ... |
| Nash (Quad.) | A | A | A | A | A | A | ... | ... | ... | ... |
| " (Model 671) | ... | ... | ... | ... | A | A | ... | ... | ... | ... |
| " All Other Models | A | Arc. | A | Arc. | A | Arc. | ... | ... | ... | ... |
| National (6 cylinder) | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | A | Arc. |
| " (12 cylinder) | ... | ... | A | A | A | A | A | A | A | A |
| Nelson | A | A | A | A | A | A | A | A | ... | ... |
| Noble | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... |
| Oakland (8 cylinder) | ... | ... | ... | ... | ... | ... | ... | ... | A | A |
| " All Other Models | A | A | A | A | A | A | Arc. | Arc. | Arc. | Arc. |
| Old Hickory | Arc. | Arc. | Arc. | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Oldsmobile (4 cylinder) | A | Arc. | A | Arc. | ... | ... | ... | ... | Arc. | Arc. |
| " (6 cylinder) | A | A | A | A | A | A | Arc. | Arc. | ... | ... |
| " (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Oshkosh | A | Arc. | A | Arc. | ... | ... | ... | ... | ... | ... |
| Overland | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Packard | A | A | A | A | A | A | A | A | A | A |
| Paige (6 cylinder) | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| " (Cont. Eng.) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " All Other Models | A | A | ... | ... | ... | ... | ... | ... | ... | ... |
| Pan (Model A) | A | Arc. | A | Arc. | A | Arc. | ... | ... | ... | ... |
| " (Model 250) | ... | ... | ... | ... | Arc. | Arc. | ... | ... | ... | ... |
| Peerless (8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| " All Other Models | ... | ... | ... | ... | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Pierce Arrow | A | A | A | A | A | A | A | A | A | A |
| " (Com.) (5 ton) | A | A | A | A | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " ( " ) All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Premier | A | A | A | A | A | A | A | A | A | Arc. |
| R & V Knight | B | A | ... | ... | ... | ... | ... | ... | ... | ... |
| Reo | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Riker | A | E | A | E | A | E | E | ... | ... | ... |
| Rock Falls | A | Arc. | A | Arc. | ... | ... | ... | ... | ... | ... |
| Sanford | Arc. | Arc. | Arc. | Arc. | A | A | A | Arc. | A | Arc. |
| Sazon | ... | ... | E | E | E | E | E | E | E | E |
| Scripps-Booth (4 cylinder) | ... | ... | ... | ... | Arc. | Arc. | A | Arc. | A | Arc. |
| " (6 & 8 cylinder) | A | A | A | A | A | A | A | A | A | A |
| Stearns-Knight | B | A | B | A | B | A | A | A | B | A |
| Studebaker | A | Arc. | A | Arc. | A | Arc. | A | Arc. | A | Arc. |
| Stutz | A | A | A | A | A | A | A | A | A | A |
| Templar | A | A | A | A | A | A | ... | ... | ... | ... |
| United (Grand Rapids,) (2½ ton) | A | A | A | A | A | A | ... | ... | Arc. | Arc. |
| " " " (3½ ton) | A | A | A | A | A | A | Arc. | Arc. | Arc. | Arc. |
| " " " (4 ton) | ... | ... | A | A | ... | ... | A | A | ... | ... |
| " " " (5 ton) | A | A | A | A | A | A | A | A | A | A |
| " " " (6 ton) | ... | ... | A | A | ... | ... | ... | ... | ... | ... |
| " " All Other Models | A | A | A | Arc. | A | Arc. | Arc. | Arc. | Arc. | Arc. |
| Velie (Model 34) | A | Arc. | ... | ... | ... | ... | ... | ... | ... | ... |
| " (6 cylinder) | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| " (Com.) (3½ ton) | ... | ... | A | Arc. | A | Arc. | ... | ... | ... | ... |
| " " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... | ... | ... |
| Vim (Models 22, 23 and 24) | A | A | A | A | ... | ... | ... | ... | ... | ... |
| " (Model 25) | A | A | Arc. | Arc. | ... | ... | ... | ... | ... | ... |
| " All Other Models | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Westcott | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| White (16 valve) | ... | ... | A | A | A | A | A | A | ... | ... |
| " (3 ton) | ... | ... | A | A | Arc. | Arc. | ... | ... | ... | ... |
| " All Other Models | ... | ... | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. | Arc. |
| Willys-Knight | B | A | B | A | B | A | A | A | ... | ... |
| Willys Six | A | Arc. | Arc. | Arc. | ... | ... | ... | ... | ... | ... |
| Winther Six | A | Arc. | ... | ... | ... | ... | ... | ... | ... | ... |
| " (Com.) | A | A | A | A | ... | ... | ... | ... | ... | ... |
| Winther-Marwin (1½ ton) | A | A | Arc. | Arc. | ... | ... | ... | ... | ... | ... |
| " All Other Models | A | A | A | A | ... | ... | ... | ... | ... | ... |
| Winton | Arc. | Arc. | Arc. | Arc. | Arc. | ... | ... | ... | ... | ... |

**The Chart first appeared when touring cars were advertised as "double phaetons"—when the fashionable automobile was characterized by red paint and a great deal of exterior brasswork.**

Today no one longer questions the soundness of the advice given through the Vacuum Oil Company's Chart of Recommendations. This Chart points the way to scientific automobile lubrication the world over. Over a million copies have been distributed in the United States during 1920. Hundreds of thousands of copies are in active use in all parts of the globe.

The Chart, and the several grades of Gargoyle Mobiloils have thus established America's supremacy in the field of scientific automobile lubrication.

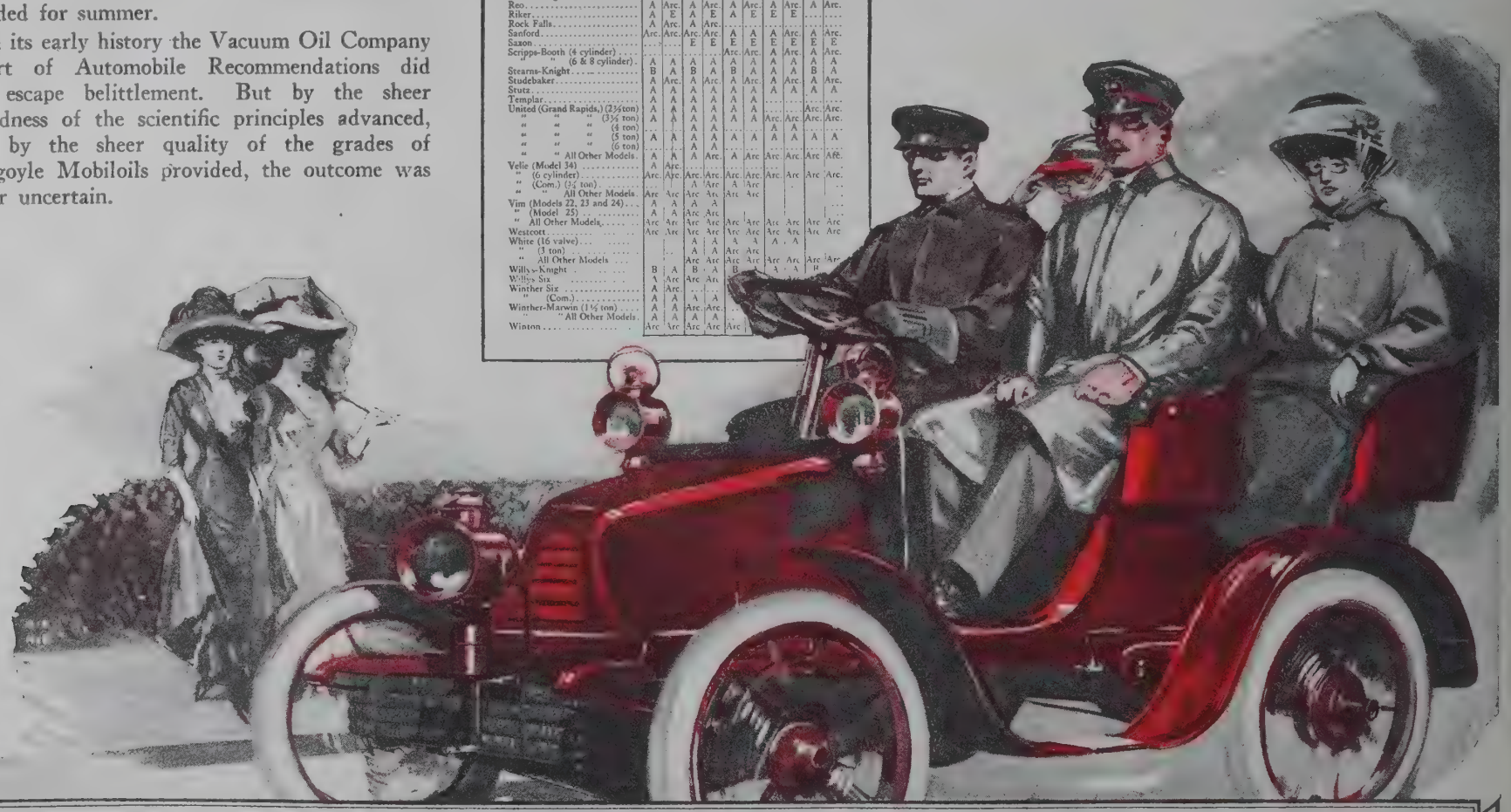
To follow the Chart is to admit that science and experience count in automobile lubrication as well as in other fields of endeavor.

If the partial Chart shown here does not list your car, send for a copy of our book "Correct Automobile Lubrication," which contains the complete Chart. Or consult the complete Chart at your dealer's.

GARGOYLE

# Mobiloils

*A grade for each type of motor*



# VACUUM OIL COMPANY

*Specialists in the manufacture of high-grade lubricants for every class of machinery. Obtainable everywhere in the world.*

# NEW YORK, U.S.A.

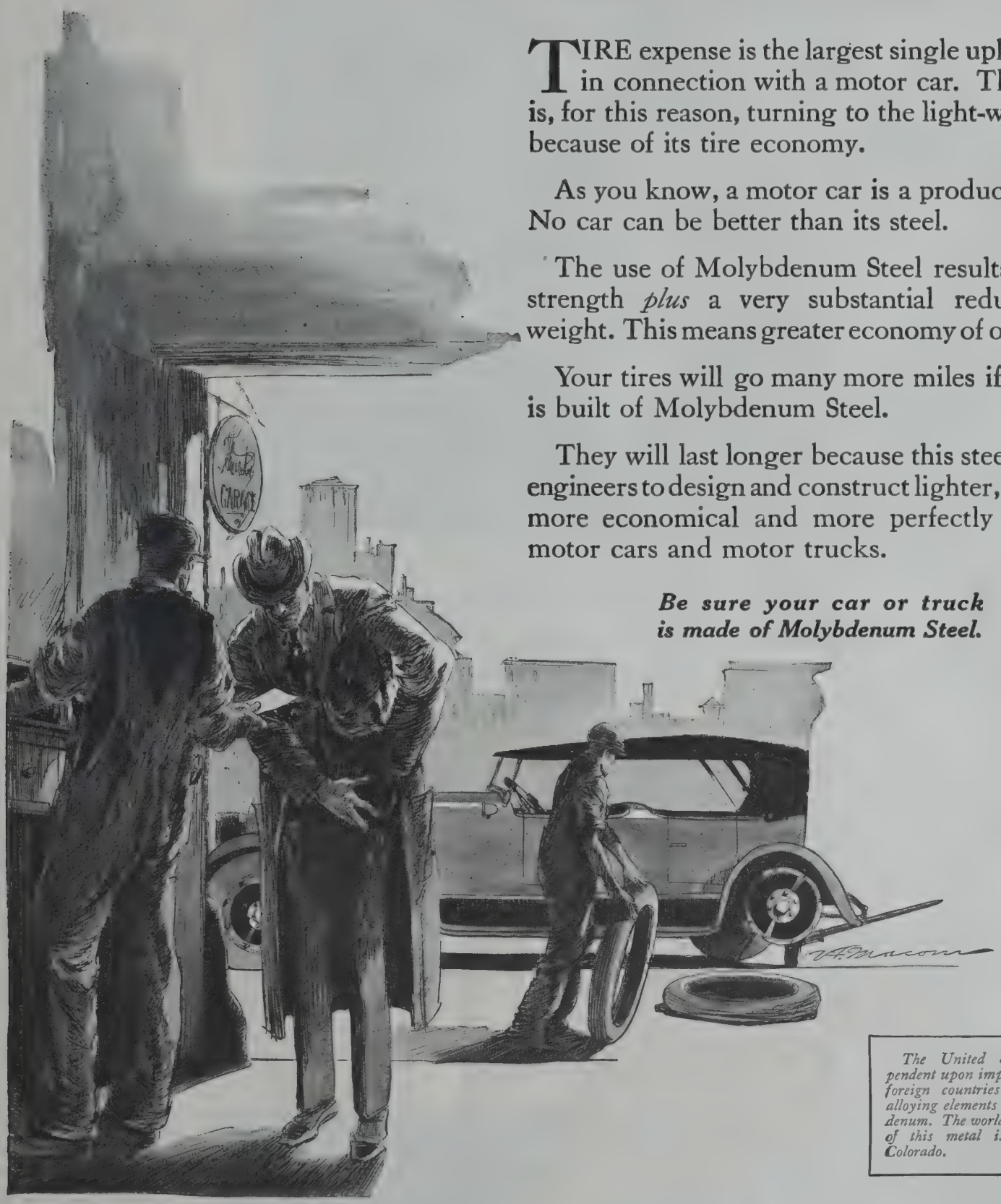
***Domestic Branches:*** New York, Boston, Philadelphia, Pittsburgh, Detroit, Chicago, Minneapolis, Indianapolis, Kansas City, Kan., Des Moines

# Mo-lyb-den-um Steel

## *The American Super-Steel*

*and*

## YOUR TIRE BILLS




TIRE expense is the largest single upkeep item in connection with a motor car. The public is, for this reason, turning to the light-weight car because of its tire economy.

As you know, a motor car is a product of steel. No car can be better than its steel.

The use of Molybdenum Steel results in extra strength *plus* a very substantial reduction in weight. This means greater economy of operation.

Your tires will go many more miles if your car is built of Molybdenum Steel.

They will last longer because this steel permits engineers to design and construct lighter, stronger, more economical and more perfectly balanced motor cars and motor trucks.

***Be sure your car or truck is made of Molybdenum Steel.***

*The United States is dependent upon importations from foreign countries for all steel alloying elements except Molybdenum. The world's chief source of this metal is at Climax, Colorado.*

CLIMAX Mo-lyb-den-um The Commercial Alloy

**Climax Molybdenum Co.** *associated with* **The American Metal Co., Ltd.**

*61 Broadway —— New York*

*Climax Molybdenum Company is the largest producer of Molybdenum in the World.*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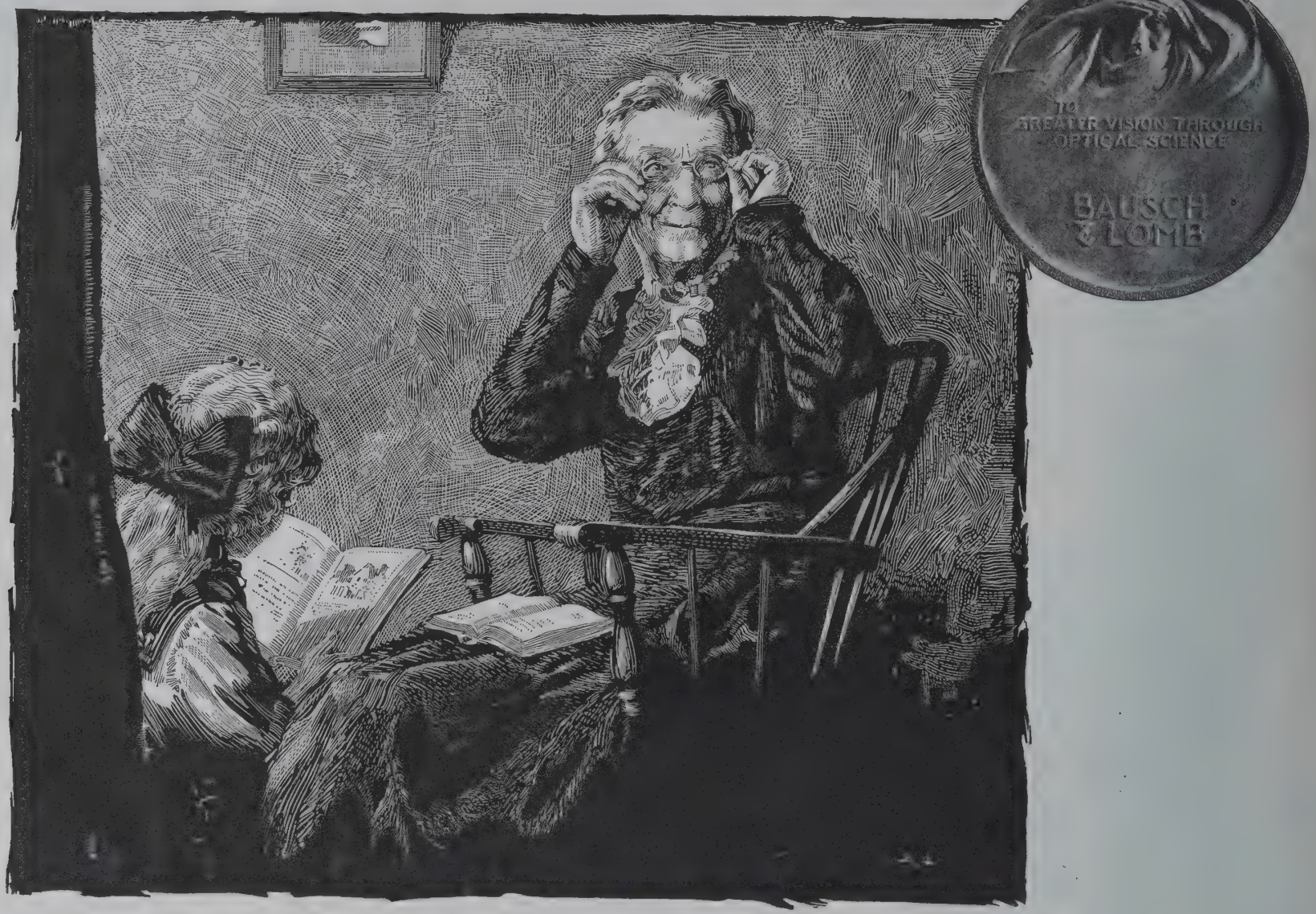



# Lighting the Pathway of Human Life

LIFE'S shadows lengthen. Twilight is at hand, and man's senses falter. Nature, calling for help, must be heeded, or happiness is threatened.

Particularly true is this of the sense of sight, most important of all to human comfort. When eyes grow dim, optical science must come to their rescue. Supplementary lenses, expertly ground of glass and skillfully applied, must re-enforce those provided by Nature.

Again, to eyes proven faulty at the morning or midday of life this co-operation of optics is even more vital. Many a defective child has been placed on an equal footing with his school fellows by a right application of glasses, has been given the opportunities and pleasurable sensations which life owes him. Many a workman has been transformed from inefficient to efficient.

While immediate responsibility for this service rests with the eye specialist, he must be given suitable lenses, with which to work, or his skill is helpless. To provide such lenses is one of the endeavors to which our resources have been consecrated since the establishment of our business nearly 70 years ago.

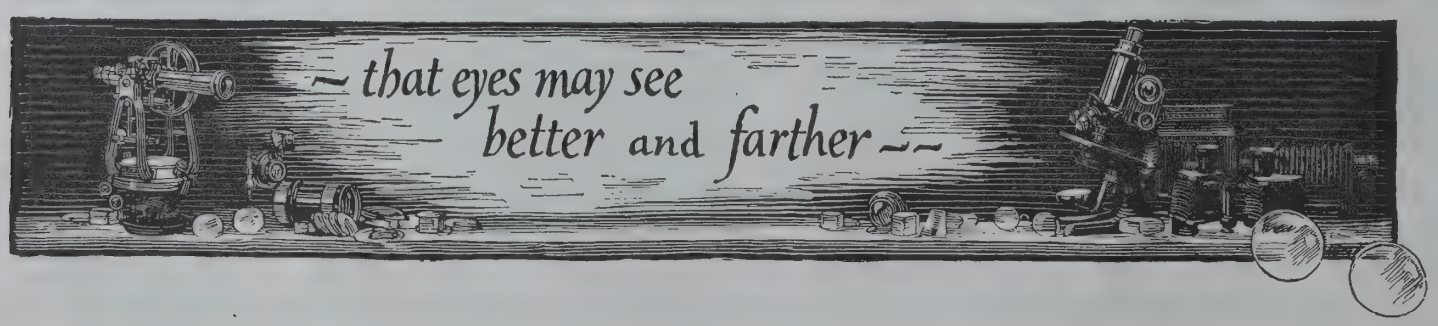
When John J. Bausch opened his little optical shop in 1853, all lenses were imported from Europe. Dissatisfied with the quality Europe was giving him, he made a lens-grinding machine and began to grind his own by hand, crudely but well. So well, in fact, that his product soon attracted the attention of other opticians, who sought him out to demand his surplus for themselves.

And so Mr. Bausch and his colleagues have been making superior lenses ever since, in almost unbelievable quantities, for the exacting optical men, not only of America but of all countries of the civilized world—scientifically developing the various types required for the correction of every kind of eye error. Nor has their service stopped here. They have come to produce, as well, practically every known type of optical appliance or instrument for the conservation and extension of human vision in science, industry and recreation.

*Write for literature on any optical product in which you are interested*

BAUSCH & LOMB OPTICAL COMPANY . . . ROCHESTER, N. Y.

*Makers of Eyeglass and Spectacle Lenses, Photographic Lenses, Microscopes, Balopticons, Binoculars and other Optical Instruments*



SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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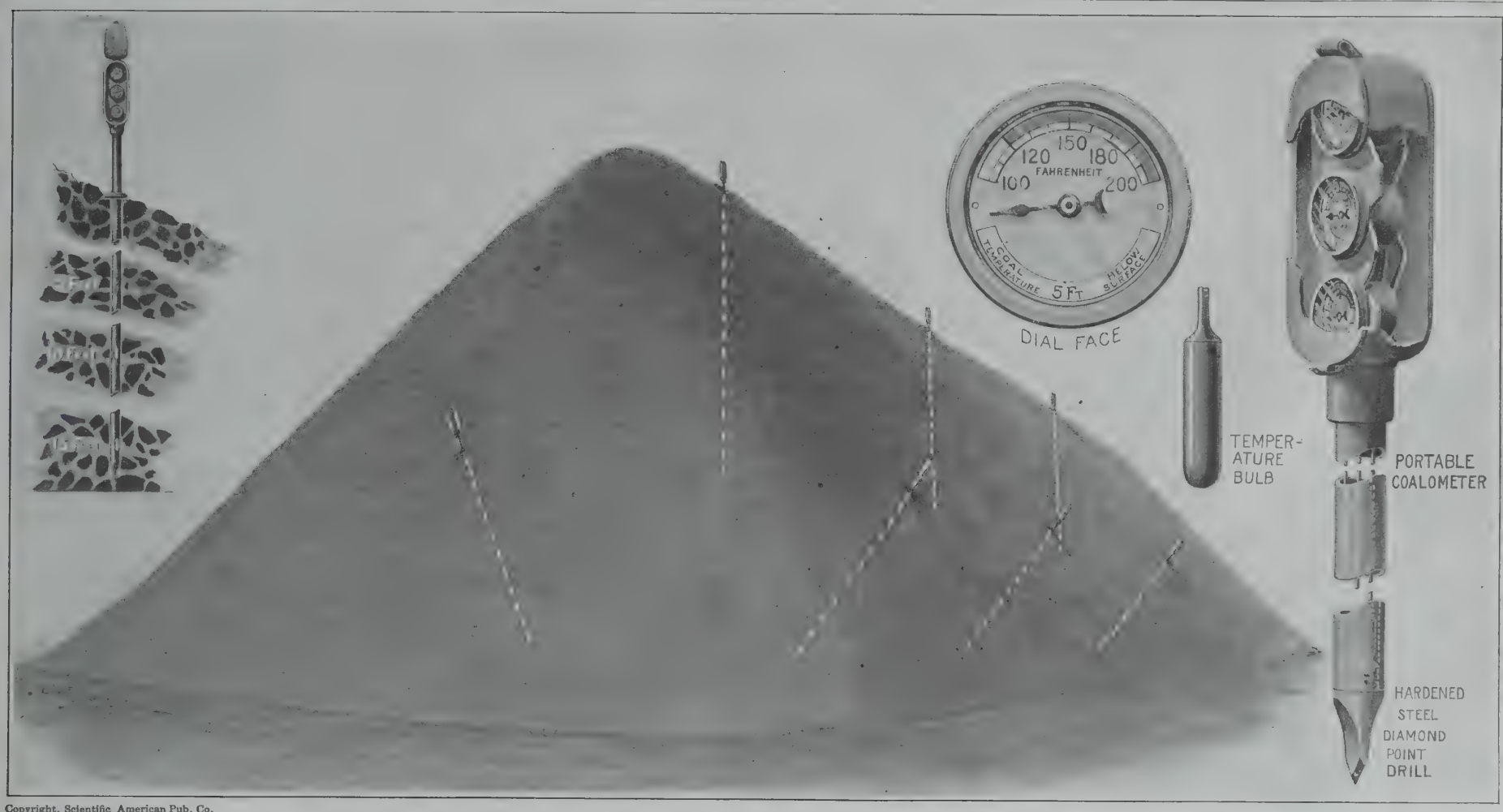


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**Details of the coalometer, which detects heat losses in the soft-coal pile, and how it is installed to keep tabs on different sections and different depths of a pile**

## Detecting and Preventing Leakage in the Soft-Coal Pile

By R. P. Nichols

A NEW device for indicating the thermal conditions of stored soft coal will be of interest to those who use bituminous fuel in quantity. For it is a fact that coal deteriorates under certain conditions. Quoting from Porter on "Weathering of Coals," 1915:

"Porter and Brunton also found that a coal pile may be covered with snow, yet 3 feet below the surface of the coal the temperature may be quite high."

The new device, known as the coalometer, was designed for either permanent or removable installations, to meet the conditions encountered whenever soft coal is allowed to lie in storage for an appreciable time, awaiting removal. The instrument in its perfected state was developed from a joint invention of Prof. A. W. Browne, Professor of Chemistry at Cornell University, one of America's leading scientists, and the writer.

As is well known, bituminous coal has the property of spontaneously heating, in certain spots, and at varying depths. This heating does not always cause actual combustion, in the sense that the coal burns with the presence of flame, though this condition is also often encountered. There does exist almost universally, however, in stored coal of this character, a slow combustion which is even more destructive than combustion by flame, owing to the fact that it cannot be so readily detected, and thus accomplishes its destructive heating quietly and unnoticed throughout an ever-increasing zone beneath the surface of stored coal. This slower escape of the valuable B.t.u.'s, for which the consumer pays his money, is equivalent to the actual loss of that amount of heating value from fire or other cause.

Could the consumer look beneath the surface of his coal pile and definitely acquaint himself with conditions existing there, he could save himself enormous losses by using that part of his coal supply first which showed a tendency to become even slightly heated.

It is for the purpose of indicating these conditions beneath the surface that the coalometer was designed. It consists of a set of temperature indicators encased in a long pointed steel tube, carrying at varying depths metal bulbs (corresponding to the bulbs of thermometers), and at its upper end a set of dials and pointers, which indicate under all atmospheric conditions the exact temperature of the bulbs which actuate them. These units are forced down into the coal pile to definite depths and at various points, and collectively furnish definite data to the consumer as to the exact temperatures existing beneath the surface. If an accurate record of these instruments be kept, periodically, the slightest rise in temperature is at once detected, and should it become excessive, the consumer at once removes this particular portion of fuel, thus saving the heating value of the coal which had started to dissipate.

Tests have shown that a coalometer installation of one unit each 50 feet in both directions from its neighbor will efficiently indicate conditions of temperature below the surface. Thus the installation of one triple unit will protect approximately 900 tons of coal if the volume is about 50 x 50 x 16 feet.

The accompanying drawing shows a triple unit coalometer for use in coal piles from 15 to 20 feet deep. A galvanized steel tube, having a hardened steel diamond point drill at its lower end, carries three pressure bulbs at depths of 5, 10 and 15 feet, respectively. Tubes from these three bulbs register temperatures in Fahrenheit degrees upon three dials, by means of pointers provided for this purpose. The scale on each dial starts at 32°F., and is colored black. At and above 120 degrees the scale is red, indicating excessive heat at any point in this zone, and warning the coal man to remove this portion of the coal. The depth of the hot spot is determined at a glance, for the dials are plainly marked 5, 10 and 15 feet, respectively. The dial showing the hottest temperature thus indicates the depth at which the heat is generating.

These dials are enclosed in weather-tight metal cases with thick crystal faces, and the set is again enclosed in a galvanized cast iron case. This furnishes ample protection when in us or in storage.

A slidable pipe wrench is provided on each unit, to aid the rapid and easy boring of the tube to the desired depth. A large, plainly-marked lug, 12 inches below the instrument head, determines the exact depth at which the coalometer is to be placed, and thus allows of no guess work on the part of the man who does the installing. The construction throughout is very rugged, and will allow of the rapid removal and stacking of one or more units repeatedly, without fear of damage to the temperature indicators themselves. These indicators are especially constructed to indicate accurate temperatures under the varying conditions encountered throughout the year. They will indicate exact bulb temperatures regardless of the temperature of the head of the instrument and will retain their calibration under conditions of extreme vibration or violent shocks.

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Our Navy and the Japanese Bogy

MORE than once since the armistice, the SCIENTIFIC AMERICAN has drawn public attention to the fact that, although in agreement with our history and traditions we are the protagonists of disarmament, and have proclaimed ourselves to be the champions of right and liberty as against might and enslavement, yet these same United States are today the only country in the world, with the exception of Japan, that is engaged in warship construction. Moreover, our plans for development are upon such a stupendous scale that we have no less than eighteen capital ships under construction, all of which are of far greater fighting power than those of any other nation.

When the great conflagration burst forth in Europe and some of us urged that we should at once strengthen our naval forces, the Secretary of the Navy, it will be remembered, deprecated strongly any such action. Today, the mighty military orgnization which broke the world's peace in 1914 has been disrupted, its arms destroyed, and its fleet sunk at Scapa Flow or distributed among the victors. Nevertheless, a secretary who, when danger confronted the country refused to make preparation, now, when the threat has absolutely vanished, would not only carry on the huge program of armament devised for a sudden war emergency, but he would even add to the battleship program which we now have in hand.

The SCIENTIFIC AMERICAN can never be accused of favoring a weak-kneed naval policy, or one that carries any color of pacifism. For a quarter of a century we have urged that the United States should possess a navy sufficient for her security and commensurate with her dignity; but we possess some sense of proportion, we hope, and the present situation that this country of all free countries should be engaged in huge military constructions at a time when others have abandoned them, seems to be both illogical and inconsistent with our own national principles.

If we wish to possess the biggest navy in the world just for the fun of it, well and good. But if this determination to build the biggest of all navies, which was first announced in an oratorical flight by President Wilson at the time when the growing wave of enthusiasm aroused by the preparedness movement was at its height—if this resolve, we say, is serious, the question arises—having this big fleet, whom do we wish to fight, or who on earth is it that is wishing to fight us? It can scarcely be Great Britain, for, in spite of our announced determination to build a navy bigger than hers, she has not only ceased all battleship construction, but has broken up three or four very powerful battle-cruisers which were under construction. Evidently, she regards the growth of our navy with perfect equanimity and is satisfied that, the Irish question and a certain type of hyphenated Irish-American notwithstanding, America as a whole has no hostile purpose back of her naval expansion.

This brings us to the question of the so-called Japanese threat, that bogy which owed its inception largely to the activities of Captain Boy Ed, the notorious naval attaché, and is now being trotted forth and dangled before the eyes of the citizens of the United States, whenever the Japanese immigration problem flares up a little more than usual in California. Boy Ed, of course, was merely drawing a red herring across the trail which led straight to Wilhelmshafen and the Kiel Canal—the more our Navy Department could be led to contemplate a bogus peril in the Orient, the less thought would it give to the very real peril in the Occident.

We call it the Japanese bogy for the reason that if there is one thing more than any other which the very wise and far-seeing statesmen of Japan regard as altogether out of the question it is that of an attack on the United States. They know full well that, so great is the preponderance of our naval strength that the issue of a naval war would be a wiping out of their fleet as complete as that which befel the German Navy.

## The Tragedy of Our American Forests

CONSPICUOUS among the abundant natural resources of the United States are, or rather were, the vast forests with which our forefathers found the virgin soil of their future country to be covered. There is a universal tendency in human nature when it finds itself surrounded by superabundance to make a lavish and wasteful use of the resources thus presented, and in this the pioneers who went out to possess the country were no exception. They selected for their use that which came most ready to hand, and what they did not use they allowed to run to waste.

It would be unjust to censure our forbears, whether pioneer or lumberman or farmer or miner, for this extravagance. It is doubtful if one per cent of those good people had the faintest conception of the extent to which the growth in population of the United States would reach and how the superfluity of their day might give place to the scarcity of ours—for it is a fact that at the present rate of consumption positive scarcity in certain of our natural resources is within measurable distance.

A recent report of our Forest Service reveals the disconcerting fact that already three-fifths of the original forests of the United States has disappeared. Furthermore, we are cutting our forests at the rate of 26 billion cubic feet of wood per year, and by way of replenishment to make good that loss in reforestation, we are growing less than 25 per cent as much timber as we are using, or, to be exact, we are providing for increase only at the rate of 6 billion cubic feet per year. Any one can see that there can be but one issue to such a policy, namely, the absolute wiping out of our once magnificent forests. Just what effect this will have upon the appearance of the country may be judged from a visit to some of the eastern countries that were once rich with forests but now, because of the total lack of renewal by reforestation, present a series of hills and valleys absolutely barren of timber.

This report of the Forest Service tells us that the depletion of our timber resources has not resulted primarily from the use of our forests but from their devastation. There are vast areas of forest lands that are not producing the timber crops which they could produce and should. Thus, there are 326 million acres of timber lands through which the lumberjack and the sawmill have passed which today are bearing absolutely no saw timber. Some of this big acreage is completely devastated. A part of it is partially restocked with trees which, we are told, are of inferior quality, while there are comparatively limited areas only which are growing new timber at their full capacity.

By way of remedy, the Forest Service makes the following suggestions: First, coöperation with States in fire prevention and forest renewal; second, extension of Federal forest holdings; third, reforestation of denuded Federal land; fourth, a study of the question of forest taxation and insurance; fifth, a survey and classification of forest resources; and, finally, appropriations for forest research.

Many times down through the years the SCIENTIFIC AMERICAN has urged upon the country the need for taking hold of this problem in an enlightened and patriotic manner. The time for action is already very late; but if we apply ourselves to the task with intelligence, energy and liberality, there is yet time to save these forests and build them up to some of their original splendor.

## The Scientific Voter

THE first Tuesday after the first Monday in November has passed into history with the usual after-symptoms on the part of the Great American Press, varying according to political complexion. The organs that had supported the winners have pointed with customary assuredness to the vindication of their party's high moral purposes; while those whose wishes were not synchronous with the desires of the majority have as usual fallen back upon the future to reveal that they were really right all the time and that the voters will be sick of their bargain before they are through with it. There has been the usual solemn poppycock about the voters having been misled by minor bones of contention so that their verdict is not to be construed as a judgment upon what the particular scribe of the moment considers to have been the major issue; and we recall no campaign in many years in which the losers were quite so well resigned to turning over the ship of state to the winners and letting them try their luck at steering it for a while.

But all this is wholly normal. There is, however, one feature of the 1920 elections which, while in full accord with the trend of the past forty years, has this year attained a development altogether extraordinary.

Of course the whole tendency of the present-day electorate is away from the rigid party demarcation which was once so universal that the mere suspicion of not having swallowed the ticket whole was enough to make a man an outcast in the social as well as in the political community. But the persistence with which the old tradition hangs on is at times discouraging. The splitting of a ticket is not necessarily an indication of sagacious choice, to be sure; but it is at least an admission that the voter is willing to attempt such discrimination. Hence by the amount of ticket splitting indulged in rather than by our own personal impressions of its success in seating good men and rejecting bad ones must we judge the extent to which the American voter is willing to attempt the exercise of judgment in marking his ballot.

We need go no further than New York State to realize that on this ground 1920 marks an epoch. It is true that in certain previous campaigns the State officials elected have been divided between the two parties; but this has happened only in years where the vote was so close that the shift of a few thousand votes would cause the candidate for, say, State Engineer and Surveyor against whom there was local feeling in some parts of the State, to run far enough behind his successful ticket to lose out himself. It is likewise true that for several years the New York voter has been confronted with a ballot which deprives him of the opportunity of voting a straight ticket with a single X, and forces him to mark individually each candidate for whom he would vote, regardless of whether these are or are not all of one party. But this merely meets the physical problem of marking the ballot, and touches not at all the mental one of deciding how to mark it; it is still far easier to make up one's mind to vote for all the Republican or all the Democratic candidates than to form and carry into the booth and put into execution a decision to mark certain names to which the star is attached and others that follow the sign of the rooster.

The bald fact on which we comment is this: Mr. Harding carried New York State by more than a million votes; Judge Miller, running for Governor on the same ticket, registered a plurality of a mere 70,000. In round numbers, the present Governor "Al" Smith ran a million votes ahead of his ticket. That this is a great tribute to Mr. Smith's personal hold on the voters is evident; but this is not the aspect that we would emphasize. If anybody had predicted, on election morning, that anywhere in the United States any candidate could by any possibility run a million votes ahead of his ticket, such prophet would have been laughed to scorn. The thing had never been done and never would. Yet it was done; in this one State alone, at least half a million voters attempted, regardless of party affiliations, to discriminate between the candidate they wanted and the one they didn't want. We submit that this is a most encouraging sign pointing toward a future when it shall be less than ever possible to fool any great number of the people for any considerable proportion of the time.

## Electricity

**Telephoning Over High Tension Lines.**—An Eastern gas and electric company has been obtaining excellent and quite practical results with directed radio or wired wireless over its 11,000-volt lines between Ocean City and Atlantic City, N. J., a distance of twelve miles. The terminal apparatus may be connected with any part of the electric system—the 110-volt lamp or 2,300-volt buses.

**Dust and Lighting Fixtures.** — When figuring on the installation of new lighting equipment it must be remembered that when the lamps become old and more or less dirty between cleaning periods the emitted light falls off about 25 per cent, according to *Electrical World*. Consequently for a desired foot-candle illumination the rating of the lamps must be about 33 per cent higher than that found necessary from calculations based on the efficiency of new clean lamps.

**Again—Electrolysis.**—During the past four months the Bureau of Standards reports that it has carried out in coöperation with the American Committee on Electrolysis, which represents the national utility associations, a number of somewhat extended investigations in the field of electrolysis mitigation in several Middle Western cities. This work has been confined largely and almost exclusively to the effect of pipe drainage on underground systems, especial attention being given to the possibility of joint electrolysis on high-resistance joints and interchange of current between drained systems. Some attention has also been given to the three-wire systems of power distribution and also to automatic substation installations as a means of electrolysis mitigation.

**Bowl Enameled Lamps.**—Rising standards of lighting intensities for increasing production in industries demand the use of larger lamps. As the size of lamps is increased there is greater brilliancy of light source and additional precaution must be taken to ensure diffusion and to avoid glare. The bowl enameled lamp has been developed for this purpose. It has a considerably lower brightness than other forms of diffusing bulb lamps and therefore gives better diffusion and can be viewed with a greater degree of comfort. When used with a reflector the enameling acts as a small semi-indirect bowl placed immediately below the filament and softens all shadows. Bowl enameling is a translucent coating of smooth white material sprayed on the bulb. It will not chip, crack or discolor and is not subject to depreciation when exposed to acid fumes, according to the manufacturers.

**Something New in Selling Lamps.**—We are indebted to *Electrical World* for these few words regarding a highly ingenious device for displaying lamps. A St. Louis company has built a wheel 20 inches in diameter on the periphery of which are mounted twenty porcelain receptacles. One side of each receptacle is wired to a common point inside the hub and the other side is connected to a segment of a device similar to a commutator. Energy is supplied to the wheel by means of brushes, and the brush on the commutator is wide enough to light two lamps at one time. The wiring and electrical connections are concealed in the wheel, and its support is mounted on the wall at a point convenient to the lamp counter. The lamps placed in the receptacles range in size from 10 watts to 100 watts of the types most frequently sold. Any desired lamp or two adjacent lamps can be lighted at will. With these arrangements the comparative size, style, and brilliancy of lamps can easily be shown to a customer and the order filled directly from stock.

**Good Work, Italy!**—Since the signing of the armistice Italy has resumed her industrial life with considerable rapidity. She has not been free from the uncertainties of radical political action, but there is every evidence that these are on the decline; Italy is at work as completely as any nation in Europe and more so than most of them. Her wealth in hydroelectric possibilities is being developed at a rapid rate. Energy for industrial purposes, while absorbed as quickly as it is produced, is extremely cheap, and in a few years it will be abundant and the whole country interlaced with transmission lines. The various companies engaged in this work are well financed and are working harmoniously in both plant and line extensions, continues *Electrical Review*. The men engaged in this business are young, energetic and capable business men, highly representative of the new spirit that has possessed the industrial life of the country. The electrification of the Italian railways now proceeding involves 4,000 miles of additional trackage. The cost of the energy is not so great a problem as the cost to the government of converting the necessary equipment, but the mileage already converted is considerable and the equipment is of a very high order.

## Science

**A New Science Center in Washington.**—Some time ago the Carnegie Corporation of New York provided funds for erecting in Washington a building to serve as a home for the National Academy of Sciences and the National Research Council. Subsequently a number of individual patrons of science contributed a fund of $200,000 for the purchase of a site, which has now been secured. It comprises the entire block bounded by B and C Streets and Twenty-first and Twenty-second Streets, Northwest, facing the new Lincoln Memorial in Potomac Park.

**Agriculture Over Frozen Soil.**—One of the peculiar features of agriculture in Alaska has recently been described by the Department of Agriculture. In the Tanana Valley, the chief farming district of the territory, the average annual rainfall is only about 12 inches, which would ordinarily make dry-farming methods appropriate, but the first few crops raised after a tract has been cleared in this region get plenty of moisture from the melting of subterranean ice. In the course of a few years, however, the ice recedes to a depth of 6 or 7 or more feet, and no longer supplies moisture to the crops. It is then necessary to use machinery which will not only pack the soil a few inches below the surface and thus hinder evaporation, but also maintain a surface mulch of loose soil, which further checks evaporation.

**Chemistry in the Newspapers.**—The news service maintained by the American Chemical Society reports that a very gratifying amount of attention was given by the daily newspapers to the recent 60th meeting of the society, in Chicago. Although the meeting occurred in the midst of a political campaign, the Chicago papers devoted about 10 columns to it, and extensive despatches sent out by the press associations were widely and prominently printed. The technical director of the A.C.S. News Service says: "The subjects which seem the most popular to date, as far as lay journalism is concerned, are flavoring extracts without alcohol, the resolution urging Congress to pass dye legislation, hydrolyzed sawdust as cattle food, all news relating to fuel and news print paper, and the announcement that America now makes 800 rare chemicals, this last being featured on the front page of the New York *Times*."

**Exploring the Upper Air in the West Indies.**—During the past hurricane season in the West Indies the U. S. Weather Bureau has carried out a program of upper-air observations in order to determine what relation, if any, exists between the "winds aloft" (as winds in the upper air are now called by the Bureau) and the movements of hurricanes. Pilot-balloon observations have been made twice a day at stations maintained by the Bureau at Key West and at San Juan, Porto Rico, and at stations maintained by the Navy at Colon and Santo Domingo; while the data obtained at the Weather Bureau and Army aerological stations in Texas are expected to help in the investigation of this subject. While the chief purpose of the undertaking was to aid in the important work of forecasting West Indian hurricanes, the discussion of the observations will probably furnish much-desired information concerning the normal circulation of the atmosphere in the West Indian region.

**Dr. Albert Einstein** has not, according to *Science*, abandoned his chair at the University of Berlin, but he has accepted an appointment at the University of Leiden and will divide his time between the two institutions. Much interest has recently been aroused by the announcement of the German physicists, L. Grebe and A. Bachem, that they have found the shift of the lines in the solar spectrum which was the third test of the Einstein theory, the others being the motion of the perihelion of the orbit of Mercury and the apparent displacement of stars due to the gravitational field of the sun, as best observed at solar eclipses. The predicted shift is toward the red and is in the spectrum of the sun's edge or limb. By making a careful microphotometric study of three spectograms of solar absorption lines the source of which is now ascribed to nitrogen, Grebe and Bachem were able to select nine lines in the ultra-violet that are free from the contaminating influence of superposed lines of metallic origin. Expressed in terms of the equivalent Doppler effect, the final result was a displacement of 0.56 kilometers per second, which agrees very closely with that predicted by Einstein (0.6 kilometers per second). The displacements of the different lines varied a good deal, but all were shifted toward the red. It is claimed that the discordant and non-confirmatory results previously published by several investigators were due to the inclusion of lines the positions of which were seriously influenced by the superposition of adjacent metallic lines.

## Aeronautics

**Aerial Regulations in France.**—At last the French authorities have drawn up a series of regulations covering the inspection of aircraft, the issue of pilots' certificates and the control of aerial traffic in France, and they are to be embodied in a decree to be published shortly. *Flight* reminds us that they are almost identical with the British regulations, in accordance with the International Convention.

**Our "R-38".**—The work on our Naval dirigible "R-38," being built at Bedford, England, is nearing completion. It is not expected that the voyage to the United States will be made before May, 1921. At that time the hangar at Lakehurst, N. J., will be ready to receive the giant dirigible. With the completion of the huge Lakehurst hangar, the United States will be in a position to construct airships similar to the "R-38."

**An Airplane That Carries Its Own Shed** has recently appeared in the form of the new Sablatnig parasol limousine monoplane, of European conception. This machine is provided with a folding tent which weighs about 75 pounds out of a total 2,200 pounds of useful load. When the planes are folded along the body, the tent covering rests on the leading edges and the propeller tip, thus protecting the airplane against the elements.

**Flying Without the Stick Control.**—By way of demonstrating the possibility of flying an airplane simply by controlling the engine and using the rudder, a French pilot recently made a flight on an 80-horse-power Morane-Saulnier monoplane with the "joy stick" tied up and sealed so that it was impossible to use it. In the presence of officials of the Aero Club of France the machine rose from the ground, circled several times around the Villacoublay airdrome and then made a perfect landing.

**New Italian Dirigible.**—Some weeks ago the new Italian dirigible "Roma" made a trial trip over Rome, proving her airworthiness, so to speak. The airship is of the semi-rigid type, with a capacity of 34,000 cubic meters. It has three pairs of 400-horse-power motors and can travel at from 68 to 74 miles an hour, but one pair of engines will keep up a speed of 56 miles per hour. This, by the way, is exceptional speed for a dirigible. There are rumors to the effect that the United States may purchase the "Roma" and bring it to this side under her own power. Originally, the "Roma" was intended for South America.

**Wholesale Destruction.**—In a recent issue of *Berliner Zeitung am Mittag* there appeared the following advertisement, which speaks for itself: "Destroyed airplane, seaplane and airship engines of different makes for sale in quantities of 1,000 to 20,000. The engines have been rendered useless and must be destroyed further by rendering the crankshafts, crankcases, cylinders, pistons, connecting rods and bearings, push rods, valve gears and carburetors useless, according to and satisfying the instructions of the Inter-Allied Aeronautical Commission of Control. All offers must be handed in before September 1, 1920. Description of how the destroying is to be carried out can be had from the ———" and the name and address follows.

**Germany's Transatlantic Air Station.**—From our British contemporary *Flight* we learn that the German airships which are to carry on the proposed transatlantic service, are to be accommodated in the Isle of Norderney off the coast of Prussia. One of the chief reasons for selecting Norderney is that it is convenient of access to the huge international airdrome projected for Bremen, the distance of 80 miles bringing it well within one hour's time of that air port by airplane service. Five hundred workmen are to be employed for a period of six months in preparing the Bremen airdrome, and the German government has already signified its desire to coöperate by offering a certain proportion of the official out-of-work funds toward wages with a view to securing useful work for the unemployed.

**German Air Mails.**—A regular air mail service was initiated between Berlin and Breslau during the Breslau Autumn Fair week, the distance between the two cities being covered in 2½ hours. The fair closed on September 11th, but the service is likely to be maintained with a view to linking up with the projected Paris-Strassburg-Prague and Warsaw air line. Another interesting development is contemplated in connection with the Berlin-Königsberg air service, continues *Aerial Age Weekly*, which is intended to extend to Reval and Helsingfors—possibly with an eye to Petrograd in the near future. The German postal authorities are also in communication with the Swiss government with a view to the early establishment of a daily air mail between Frankfort-on-the-Main and Basle. Air mails have been running daily between Berlin, Bremen and Wangeroog, and no accident has occurred.

# Making the Barge Canal Pay

## What Is Needed to Give New York's Waterway the Standing It Should Have

By Frank M. Williams, State Engineer and Surveyor of New York

FROM the Great Lakes there are two barge canal routes to the Atlantic Ocean; one by way of the Welland Canal, across Lake Ontario to Oswego; up the canalized Oswego River and by way of Oneida Lake and the Mohawk River to the Hudson at Troy, thence on tide water to New York; the other route is more direct and also less hazardous. It follows the Niagara River from Buffalo to Tonawanda and thence direct across the State of New York to Troy. This route is practically the same as the Erie Canal, the opening of which was celebrated less than one hundred years ago.

The Barge Canal, which is the name given all the channels in New York's new canal system, has been constructed to a depth of 12 feet and the Superintendent of Public Works is required to maintain it to that depth. To do this requires constant attention and much dredging: nevertheless the channel has been maintained at the dimensions required and there is no reason to believe that this cannot always be done without interfering with navigation or hindering the barge fleets. The locks of the Barge Canal, of which there are 35 on the direct route between Lake Erie and New York, give the controlling dimensions for the boats, because barges constructed within the limits of the lock chambers can pass through any other portion of the waterway. These structures are uniform; their usable length is 300 feet and their width 44½ feet. This does not mean that it would be practicable to operate boats 44½ feet wide on the canal for there are other controlling factors. The width in the artificial sections of the channel is 75 feet on the bottom, hence in order for two loaded barges to meet and pass at speed, their width should be something less than one-half of 75 feet, or else passing basins must be provided which would, of course, be the source of considerable delay. Other controlling features are economical considerations. It has been found that there should be a certain ratio maintained between the width of the vessel and the waterway and that this should not be materially exceeded if resistance to the movement of the vessel is to be reduced to a minimum. This ratio varies but may be taken on the average as 1 to 6. With a waterway 130 feet wide, which is the surface width of the artificial sections of the canal, a vessel should be approximately 20 to 22 feet wide. As the new locks are 44½ feet wide it can be seen that two boats of 21 feet beam can be placed side by side in the chamber. The practical length of a boat of that width is 150 feet. Therefore, four barges each 150 by 21 feet can enter and pass through the locks at one lockage.

Practical and economical factors show that barges, on a long, limited depth channel, should not be loaded to more than four-fifths of the full depth of water. This is primarily due to the requirement for a water cushion under the keel so that space will be provided which will allow the operators to maintain a proper speed with a minimum of power. For special purposes larger boats may be used and it is quite possible that as greater experience is had a larger type of carrier may be developed. One of our large shipbuilding corporations has under construction self-propelled barges designed to carry 2,000 tons of freight and it is planned to operate these as single units. Plans have also been prepared for vessels claimed to be designed for lake as well as canal purposes and one of the designers contemplates the construction of carriers 250 feet long and 36 feet wide to move in fleets of four, one being a power barge with 1,000 horse-power. Each of these barges is designed to hold 1,650 tons which would give a total fleet capacity of approximately 6,000 tons. Such a fleet would require four lockages, but it would have the advantage of being able to move safely on the Great Lakes. However, New York's waterway was designed and built as a barge canal and was not originally intended for other purposes. Many believe that the future of the waterway lies primarily in carrying out its original purpose, although they would encourage those who are attempting to construct carriers that can withstand the storms of the Great Lakes and also move through the Barge Canal. Basically, however, the proposition before the designers is one for constructing efficient canal carriers and not adapting canal boats to lake use. Authorities, in making this assertion, have principally in mind cheapness of construction, ease of movement, adaptability to freight, etc. On these grounds they advise that, for all general canal purposes barges 150 feet by 21 feet and having a loaded draft of not more than 10 feet, be constructed. These boats if moved in units of four, one being self-propelled, will move as much freight as three freight trains, consisting of 50 freight cars each and will operate at a rate of approximately 100 miles a day whereas, under normal conditions, freight trains moving low grade commodities average but 25 miles a day.

The United States Government is operating 73 barges and 21 cargo steamers on the Barge Canal. The Inland Marine Corporation has 50 barges and 10 steamers, the

(*Continued on page 553*)

1. A floating drydock constructed by one wide-awake boat-builder for the repair of damaged canal boats. It will accommodate barges 150 feet long and 22 feet wide. 2. Semi-portable revolving jib cranes installed on the Barge Canal Terminal at Pier 6, East River, New York City. 3. A typical oil tank station along the barge Canal. The Standard Oil Co. has constructed many of these, and since the Canal was completed not a single gallon of oil has been delivered to any of them except by barge. 4. Fuel-oil-burning barges with tows at the Troy Terminal. 5. Conveyor cranes of 1½-tons capacity at the New York Terminal

**Some of the appurtenances that will help the New York State Canal to make good in handling its due share of freight traffic**

*Left:* Ancient tank, believed to have been built by Pontius Pilate, now recemented and used by the British. Of the two covered pipe lines paralleling the road, one collects water from the spring-houses and the other conveys it to Jerusalem. *Right:* Egyptian labor corps working on the construction of water reservoirs

**Examples of what British administration is doing for the water supply of Jerusalem**

## Jerusalem's New Water Works

**By H. J. Shepstone**

NOT the least of the many blessings which the British have conferred upon Palestine as a result of their occupation of the country is the giving to Jerusalem of an ample water supply. Before their coming the Holy City was virtually dependent upon the rainfall for its water, collected and stored in cisterns. Many of these latter were situated under the houses or at the back of the premises, and generally hidden from view. Water gathered during the rains on the flat roofs was conducted to them by pipes, and there stored until wanted. Many of these cisterns were found to be in a sad state of repair, and, what was worse, were the breeding places of many germ-carrying insects. The military authorities had them all cleaned out and repaired. Some of them had not been cleaned for a hundred years and more.

But these rainwater cisterns were not sufficient to supply the city's needs. Ever since she has been under Turkish rule Jerusalem has suffered from the lack of a good water supply. Except for one small spring, the Virgin's Fount, so named because it is believed the Mother of Christ drew water from it, Jerusalem cannot boast of a single fountain. It is situated outside the city in the Kedron Valley. True, a year or two before the war the Turks built a four-inch pipe from the old Pools of Solomon, to the south of Bethlehem, to the Temple area, but the supply was limited and for the most part reserved for the mosque. Even in Solomon's days the want of water was felt, and he obtained his supplies from three reservoirs built in a valley just below Bethlehem. From these water was brought to the city by an aqueduct.

Over and over again engineers and others offered to repair these reservoirs and build a modern aqueduct, but the Turks always turned the proposition down, or put obstacles in the way, with the result that Jerusalem had to depend upon the scanty rainfall for its water.

It was early in February, less than three months after the capture of Jerusalem, that the British began to grapple with this serious question. They went first to the Virgin's Fount and made an exhaustive study of this historic and interesting spring. As a result, they discovered that it was not an ordinary intermittent spring, but rather a fountain of the character of a geyser, for the flow occurs three to eight times a day, the output varying from 2,000 to 11,000 gallons each time. It was from this very spring that Hezekiah, over 2,600 years ago, conveyed water by means of a tunnel to the Pool of Siloam. Pipes were laid from the spring and water was pumped up to tanks in the Valley of Jehoshaphat, near the northeastern corner of the city wall.

Although this greatly improved matters, the supply was still found to be insufficient to meet the ever growing demands of the city. An examination was now made of the Pools of Solomon to the south of Bethlehem. In the end, however, it was decided to repair and use the old reservoir, now known as Birkett Arroub, lying a few miles to the south of Solomon Pools. It was built by Pontius Pilate and it was from here that he brought water to the city in the days of Christ.

Pilate's old reservoir was repaired and enlarged, its capacity today being 5,000,000 gallons. Galleries were built in various directions to tap the numerous surrounding springs, including those of Ain ed Dirweh, in which, it is said, Philip baptized the eunuch. A powerful pumping plant was installed by which the water is pumped up to large reservoirs built on higher ground on the Hebron road, the water flowing from here by its own gravity in a one-foot iron pipe to twin pools on the hill west of the city, from whence it is conducted to various stand-pipes in and around Jerusalem.

Pilate's aqueduct, ruins of which dot the landscape today, stretched for a distance of forty miles, though as the crow flies the Holy City lies but thirteen miles away. The British pipe line, however, is but fifteen miles in total length. As a result of this enterprise the death rate in the city has dropped by one-half.

## Light Burning in California Forests

**By Charles P. Fryer**

STANDING redwood trees are almost immune from forest fires and this fact necessitates a distinction between the redwood and pine forests in California in any consideration of light burning, a test of which is advocated by the California Forest Protective Association and other private associations and lumbermen for the sake of clearing the forest floor of debris and thus preventing big destructive fires.

In the redwood forests slashings and underbrush occasionally cause fires hot enough to burn to the tops of redwood trees, destroying their branches and foliage but in nearly every case they put out new foliage the next season. This immunity of redwoods to fire is due partly to the climate of the redwood region and partly to the absence of resin in the wood and its thick non-combustible bark.

The primary pine region extends from the Oregon line south through the Sierra Nevada Mountains following closely the line of winter snows and being 2,000 to 3,000 feet above sea level. The timber is in open, park-like stands and in early days the forest floor was kept clear from brush and litter by the light burning practised by the Indians and the occasional fires caused by lightning. The trees passed through several centuries of these fires to make splendid timber.

In these days of close fire prevention and control a rank growth of underbrush has sprung up in California pine forests and there is much debris in places. This causes hot fires which are hard to control and often burn mature trees.

Fire tends to prevent fire as is shown by the small timber losses of 1912 and subsequent years, following 1910, in which year forest fires were the most disastrous known for years in California. Since 1915 the loss each year has been greater than the season before, increasing from less than 2 per cent of the 1910 loss in 1915 to over 60 per cent in 1919, thus showing that the underbrush is accumulating.

*Left:* Top of the water tank constructed by the British military authorities in Jerusalem. *Right:* Interior of the pumping station at Arroub

**New construction by means of which Jerusalem is freed from dependence upon casual sources for her water**

# One Hundred Years of Gas Lighting

## An Account of the Early Days of This Art, Which First Stood on Solid Ground in 1820

By William Ressman Andrews

THE centenary of illumination by gas practically falls in this year. Eighteen hundred and twenty was the dividing line between the experimental stage of gas lighting and the period of its demonstrated practicability. The history of its expansion is similar to other discoveries in physical science which have developed factors now recognized as fundamental in the advancement of modern civilization.

As in the case of steam and electricity, its practical application to everyday use came long after the researches of the original investigators. Although this general recognition was somewhat tardy at first the progress made in gas lighting was rapid from the time, in 1820, that its merits became thoroughly established. Street illumination by gas was introduced in Paris by Frederick Winsor in that year and thenceforth was extended generally throughout Europe. He organized, some time before, the first gas company in London and was known from the successful culmination of his Paris venture as the "father of modern gas lighting."

In America, too, the feeling, that gas—introduced in Philadelphia and in Baltimore in a tentative way and with some misgivings at an earlier date—had proved to be a practical means of lighting, began to take strong hold on the public mind in 1820. An important improvement which increased the popularity of the new illuminant was made in this year. This was the invention by J. B. Neilson of the Glasgow Gas Works in Scotland, of the "fishtail" burner, or union jet, which gave greater luminosity to the flame. Furthermore it was largely this year which saw the fruitful efforts of scientific men who, having realized the boon of gas lighting, had set forth its advantages in their writings.

Chief among them was Fredrich C. Accum, a Westphalian chemist, living in London, who had published a short time before a "Practical Treatise on Gas Light." This epoch-making work on the subject was immediately translated into French, German, and Italian. The municipal authorities of the continent were at once impressed with the fact that they now had the means at hand to lessen considerably the dangers which from time immemorial had lurked in their streets and alleys after nightfall.

A high degree of pioneer activity characterized the experimental and promotion period. Passing over the earliest events connected with the subject—such as the fitful industry of an ecclesiastical dilettante in England who amused himself by filling bladders with the fumes of coal distilled on the hearth of the rectory kitchen—it was reserved for the experiments of a Scotchman, William Murdock, to point the way to the possibilities of a new illuminating agency. He was the first to show that gas could be made on a large scale for lighting purposes. The experiments were conducted near the close of the eighteenth century at Redruth, Cornwall, where his house was lighted at first by a flame emitted from the crudest form of jet—or rather the absence of a jet. The gas was consumed as it flowed from the open end of an iron pipe. The gas consumption was of course out of all proportion to the volume of light obtained. But he checked the waste by welding the orifice and then boring three small holes in a way to produce three divergent flames. There was now less gas consumed, but the light was poorer. In the next step Murdock flattened the end some little distance down the pipe and bored a number of holes close together along the top. This arrangement produced a series of flame spurts which greatly increased the illuminating power of the burner, called, on account of its shape, the "cockspur."

Shortly afterward the scene of his experiments was transferred to England. The engine factory of Boulton, Watt and Company, at Soho, near Birmingham, was lighted with gas by the Scotch inventor. Its successful application here revealed the fact that the ubiquitous candle and its pushing rival, the whale oil lamp, would be obliged in time to give way before the acknowledged superiority of the new illuminant.

The stage of development which followed was marked by the introduction of a saw-cut across the top of the welded end of the pipe to take the place of the row of small holes. As a result the gas burned in a sheet of flame resembling a bat's wing, and this form of burner was on this account known by that name.

Murdock's later experiments included the adaptation of the principle of the Argand burner, which had a ring of holes at the top of a hollow cylinder through which the air circulated. The draught passing through the center of the cylinder was necessary to insure proper combustion; also the flame, to be of any service, had to burn without flickering, and these requirements were obtained by the use of a chimney.

At first iron tips were employed in the flat flame and the Argand types, but they were soon discarded for tips composed of steatite and similar substances. This improvement came about when it became known that the light intensity depended upon the degree of heat in the flame. Hence the use of non-conducting material for gas tips to keep as much of the heat as possible in the flame itself.

The improvement made by Neilson over these jet forms was based on a simple process. He discovered that the light burned much brighter when two streams of flame were made to strike each other squarely. The impact spread the blaze out into a flat flame. The burner in a short time was universally adopted. The use of clay retorts and the introduction of sulfate of iron as a purifier are other contributions made to the progress of gas lighting by this Scotch mechanical genius.

In another method of purifying gas lime purifiers were employed, the invention of Samuel Clegg, who contributed to an elaborated treatise on gas making brought out by his son in 1850, a volume which proved to be of great value in spreading information as to the advantages of gas lighting. The elder Clegg was also the inventor of a water meter for measuring gas. His device has proved to be the basis of the improvements since made in gas measuring methods.

The year of Neilson's discoveries which evolved the union jet saw the introduction of gas in Boston, and in 1823 there were twenty-three cities in Europe using gas. Berlin, the city from which so much "natural gas" about world dominion was to escape later on from royal lips, began to illuminate its streets and houses in 1826. Dresden followed in 1827 and by 1850 gas had been introduced into twenty-six German cities.

The use of gas in Baltimore dates from 1816; New York, 1823; Brooklyn, 1825; Boston, 1828; New Orleans, 1833; and Cincinnati, 1840.

The New York date is associated with the name of a family long prominent in the business and social life of the city. In that year Samuel Leggett organized the New York Gas Company. It was incorporated at $100,000 and obtained a 30-year franchise to lay pipes south of Grand Street. In September they were laid in the principal thoroughfares and were very different in appearance from the huge metal mains we are accustomed to see nowadays. Wooden logs, laboriously pierced by the primitive tools of the period, and tapering at the ends, served to convey the gas to the point of use. Leggett's house, at 7 Cherry Street, was, according to tradition, New York's first dwelling to be lighted by gas. In 1825 Broadway from the Battery to Canal Street was added to the gas illuminated area.

At that early day in the history of the industry in America, coal was not used for the distillation of gas, except in the anthracite regions. Coal was being shipped from Newcastle and Liverpool and the expense of such importations put coal far beyond the reach of the gas manufacturers who might have been considering its use outside the anthracite sections. Leggett's company distilled its gas from resin, which in his time was cheaply transported by water from the South. The gas fixtures and burners were not made in this country at that period but were brought over from England.

A great advance in gas lighting was brought about by the introduction of the atmospheric burner in 1855, the invention of R. W. von Bunsen. It marked an important stage in the history of gas because it made possible the use of coal gas for heating and cooking purposes.

But a more important invention came from the hands of a man who had been a student under Bunsen—Karl Auer Welsbach, whose burner, known the world over by his name, has achieved a striking and impressive distinction. According to Prof. H. Bunte, in a paper read before an International Gas Congress in Paris, a short time after the Welsbach burner had been introduced in 1886:

"The Welsbach lamp is now the recognized form for both private and public use; the older types are continually losing ground. It has effected a complete revolution, not merely in regard to the illuminating effect and the economy of gas lighting, but even the fundamental factors by which gas is valued and the properties and the manufacture of gas have been entirely altered."

The inverted incandescents, a development of the Welsbach principle, first made their appearance in 1900, and proved to be more satisfactory than the upright lamps. Another strong point in the appeal made by the lamps burning in reverse order was their adaptation to decorative treatment.

When Professor Bunte addressed the Paris assembly the Welsbach light seemed to be the last word in illumination, and yet it was the dawn of an inconceivably greater illuminant — electricity. While electricity is superior to gas in one respect, it may be asserted confidently that gas will hold its own for some time with overworked housewives, who for the last decade have been relieved from the drudgery and uncertainty of the coal range.

*ONE of life's little ironies for the editor of a sheet like the* SCIENTIFIC AMERICAN *is the frequency with which he is asked to state name and date for an "invention" which in reality was not at all a single invention by one man, but came rather through a long series of experiments and semi-commercial developments by many men. If we name the first of these men as the inventor, we are immediately challenged to show just what he invented; if we name the last, we are driven into a corner and compelled to acknowledge his indebtedness to all his predecessors. With all this in mind, it was with considerable diffidence that we followed Mr. Andrews into his effort to establish 1920 as the centenary of gas lighting. But we believe all readers will agree that he has made out a passable case, and that he is entitled to say that the present year comes about as close as any year can to rounding out an even century of this style of illumination.*—THE EDITOR.

## Attractive Farm Signs

ONLY a few years ago the signs encountered in a farming district were all of clothiers, hardware houses, druggists, and other city stores, or of tobacco manufacturers, medicines for man and beast, baking powders, and the like. These varied interests saw an advertising opportunity in placarding the countryside with metal and wooden signs. But times have changed. The signs one now sees in growing number are more and more the farmer's own, designed to convert to his own use such advertising opportunity as exists.

Some of the signs are to advertise products for sale, the appeal being to the passing auto traffic. Another use of signs is to advertise the fact that the farmer is the member of the local farm bureau, and a supporter of its project. Some Western districts are using the farm sign, or are planning to, in a campaign to displace the scrub animal.

The other day a large California coöperative association, the Prune and Apricot Growers Association, placed a big order for baked enameled signs, in colors, to be posted on the orchards of members. This association will need over 10,000 to begin. These snappy, up-and-coming signs will help to maintain the prestige of the association at home, and incidentally will be a good advertisement to all visitors. The prune and apricot growers are not the first to use them—the raisen growers, the citrus growers, and the walnut growers already do.

Thus we see that the roadside sign is not disappearing, only changing in character. It becomes now a business device of the progressive farmer. And in this new use, ultimately, it is to be expected that it will lose the ugliness which formerly always was associated with it. The users of the old-time country metal sign were indifferent to its appearance, so long as it "advertised." Farmer-users won't long be.—By *J. T. Bartlett.*

# Tuning and Testing

## How the American Automobile Engine Is Limbered Up and Tested for Flaws

By George Gaulois

THE best grade of American manufactures of all kinds are today meeting severe tests with complete success. The higher quality of American watches excel the Swiss product at one-third the price. American machine tools lead, not only because of their ingenuity and cheapness, but because of their excellence. And American automobile engines, in spite of the glamor which with some people still hangs about the word "imported," are equally superior in spite of the far larger numbers produced and the far lower price.

In this story we are dealing with American automobile engines produced by the quantity production system.

Aside from the test which comes from actual experience, the best data can be obtained on the performance of any engine by an inspection conducted on the dynamometer. This method of testing is used to a greater or less extent in all the high grade automobile establishments in America. Its operation gives vivid example of the reasons for the superiority of the American engines.

In one leading plant, for instance, every engine turned out must pass the dynamometer tests. In spite of the most careful work in the manufacture of parts and most careful assembly, an engine, whether made by European or American processes, is so "stiff" that it is practically useless when completed. At that stage it is barely able to run itself and far less to propel a vehicle. The engine testing combines the functions of taking the stiffness out of an engine and that of reserving its quality to the most minute detail.

When the engine first comes from the assembly, it is put upon what is known as a "lapping-in stand," where it is driven by an electric motor until the internal resistance is reduced to a little above four horse-power. With the cheaper grades of engines, this "lapping-in" with a general inspection of the engine is all that is required and it then goes into the car. With the higher grade engine, the tests have merely begun at this point.

When a motor is taken from the "lapping-in stand" where it has been tested in thirty-six points, it is carried to the "silent rooms." These are completely enclosed so that no outside noises will prevent the detection of the most delicate fault in the engine. In this room is the dynamometer, which consists primarily of a generator mounted on bearings so that it may turn easily but attached to a scale so that it will not turn but the amount of torque will be measured accurately. Besides this, there is a tachometer which gives the number of revolutions that the engine under test is making per minute.

From these two instruments can be calculated exactly how much horse-power is being developed. If, for example, the scale shows a turning impulse of 111.1 pounds and the tachometer 2,000 revolutions, the formulæ show that the engine is developing seventy-four horse-power.

The other furniture of this room includes the switchboard, the jack for the motor and the pipe connections for oil, gasoline, water, etc. There are special instruments provided, including thermometer, compression clocks and a stethoscope.

The engine here is put through a series of 114 different tests. These cover the operation of the engine itself, of all its accessories, of the crankshaft assembly and of the transmission. In making them, the engine is run under its own power until it is thoroughly warmed up and the tests are then made under conditions which are almost exactly those of actual work.

The minor details of the engine are examined first, including the spark plugs, the valves and their timing, the ignition and feed system, the carburetor adjustment, and a general examination to make sure that there are no leaks in any of the water, gas or oil lines or in cylinder heads or crankcase.

The more important and delicate of the tests is made with the stethoscope, as shown in our current cover illustration. This differs from that used by a doctor only in the fact that it has a brass cone instead of a diaphragm disk. The point of this cone is moved over the motor inch by inch, and with it the tester can detect and locate noises which are entirely beyond the reach of the unaided ear. The use of the stethoscope is a comparatively recent development. In the old days, the tester hunted for these faint noises with a screw driver, holding the bit against the engine and the handle to the ear.

The noises which are detected in this way indicate trouble in embryo only There is no possibility that the buyer of an engine would detect them if the car were sent out without this inspection. But they all denote some weakness which might develop after the engine had run some thousands or tens of thousands of miles, and the pains taken to find and correct them gives insurance of long life and perfect performance by the engine.

If this test is made without trouble being detected, it has been made doubly certain that the engine is as near perfect as possible and far more perfect than nine out of ten of the best jobs that can be turned out by the hand-fitting process.

The test of the engine has not been completed, however. Following the stethoscope examination, the "power curve" is taken at 400 revolutions a minute, then at 500 and so on at every hundred up to 2,000. The engine is then set for 1,000 revolutions and there is another stethoscope diagnosis for troubles that may possibly have developed through the hard work done. Transmission and auxiliaries are then checked for noise, lost motion, amount of play and all other possible ills. No motor may be passed that suffers from what the instruction sheets describe as "vibration, knocks, growls, or rumble."

The engine is then tested for compression. A special gage is shoved into priming valves to try the compression of each cylinder separately. On this engine a difference of only five pounds in the compression of each of the twelve cylinders is permitted. If an engine

(*Continued on page 555*)

# Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

### The Finger Nail Phonograph

To the Editor of the SCIENTIFIC AMERICAN:

The following odd discovery in connection with phonographs may be of interest, and if published, may lead someone along new paths of inquiry:

If the nail on the forefinger of the right hand be slightly sharpened and filed, so that it will fit into the groove of a record while in motion, a faint reproduction of the record may be obtained. The sound is very minute, and the best method of hearing it is to lay the right ear against the hand. In this way the record can be clearly heard and the words of a song can be easily distinguished.

It would be interesting to know the reason for this peculiar phenomenon, and perhaps some anatomist or scientist may be able to supply a solution.

If a needle be held between two fingers no sound is heard.

Ottawa, Ont. R. E. SNEYD.

### Movie Science

To the Editor of the SCIENTIFIC AMERICAN:

The moving pictures are no whit behind the newspapers in the matter of highly original contributions to science. There was recently exhibited in this city a picture showing a diving bell, by means of which submarine photographs could be made. After showing the bell suspended slightly above the deck of a steamer, with the photographer crawling in under it, then being lowered into the water, the following illuminating explanation was flashed upon the screen.

"The diving bell has no bottom, the water being prevented from entering by the vacuum which is formed."

Surely that must have been a powerful vacuum! Hereafter, in order to prevent burglars from entering my house I shall remove the massive oak door and block up the doorway with an empty space. Sir Oliver Lodge tells us that the ether which fills all space, whether otherwise occupied or not, has a density of a thousand tons per cubic millimeter, and a tensile strength of $10^{22}$ tons per square millimeter. That ought to stop something.

Los Angeles, Cal. M. C. MOTT-SMITH.

### The Hudson River Crossing

To the Editor of the SCIENTIFIC AMERICAN:

I read with great interest in the latest edition of your most useful paper an article on the probable effect of CO in the tunnel to be built under the Hudson.

The true solution is a bridge over that river. While the best terminals for that bridge would be the Palisades and the hill at 10th Avenue and 62nd Street, the problem of foundations will have to govern the site of the bridge. I believe the Pennsylvania Railroad tunnels rest on caissons which in turn rest on bed rock, showing that in some parts of the Hudson caissons can be sent down to rock.

Permission for these foundations and piers must be obtained from the War Department and herein lies the real difficulty. To persuade that monument of conservatism to grant permission for such a great public improvement seems hopeless. However the attempt should be made. Only by an overwhelming public demand can anything be done.

On such subjects your journal is the most influential paper published and I hope you will make the attempt to start public opinion in the right direction.

New York. F. A. DE PEYSTER.

### Postponing Payment

To the Editor of the SCIENTIFIC AMERICAN:

Referring to your editorial on "Our Surplus, Our Ships and Europe's Need," I would inquire how these surplus commodities of a value of two billion four hundred million dollars are eventually to be paid for? This is the difficulty, for temporary means to finance the transaction are quite simple. The problem is, with reference to the payments in the future.

The ten billions which you say we have loaned Europe probably refers to the moneys loaned by the United States Government to the governments of Europe and as this money was spent in winning our war, there is some question as to whether it will ever be paid. But in addition, the countries of Europe owe to individuals in the United States about five billion dollars, and the interest on this debt must be paid, and unless the money is permanently invested in Europe, the principal must also be returned. If in addition to the five billions we add two billion four hundred million, it will mean that Europe must send to us in interest five hundred million dollars or more a year, and as there does not seem to be much chance of Europe shipping gold in such quantities, we must make still further investments in Europe, if we do not accept merchandise in payment of the interest. In other words, to the extent of this interest, our imports from Europe must exceed our exports. If the principal is to be paid and not invested abroad, the value of our imports over exports must be even greater. Should the interest be invested abroad, we will only postpone the day when we will be obliged to accept great quantities of merchandise as interest on our loans.

Tenafly, N. J. EVERARD B. MARSHALL.

### Use of Light for Reproducing Sounds

To the Editor of the SCIENTIFIC AMERICAN:

Referring to a note on page 402 of your issue of 16th October, I may say that the idea is *not* new, having been worked out in practical form 20 years ago and patented by Prof. Ernst Ruhmer (see his book on Wireless Telephones). I myself worked out the full details independently of him but went no further to popularize the matter when he took out his patents. About 5 years ago as his patents were expiring, I tried to interest a New York film manufacturer and he referred me to a talking machine manufacturer who referred me back, and as I had other things to do I had no time to go further.

I may add that in my own design I used what I think an improvement, viz., a semicylindrical lens to give the line image on the film. I had noted for experiment many points such as the use of heat rays and also the use of ultra-violet rays (for example as promoting discharge between terminals). Possibly, as the matter seems again arousing interest some note of a fuller character by you would interest the public.

Victoria, B. C. D.

*Left:* Near view of the "Pinta," showing the roomy cabin, the twin Liberty engines, and the navigating cock-pit to the rear and just above the cabin, between the engines. *Right:* Interior of the passenger cabin, showing the plain but comfortable appointments

**Two views of the "Pinta"—one of the flying units employed on the Key West to Havana air line**

# The Dawn of American Commercial Aviation

## Why We Have Trailed Behind Europe and How We Hope to Catch Up in the Near Future

By Ladislas d'Orcy, M. S. A. E.

*THERE is no use mincing words: the American aeronautical industry is decidedly at a low ebb. Following the Armistice and the suspending of heavy Government orders for airplanes of all kinds, our aircraft manufacturers found themselves with a large stock of raw materials and expensive plants, with little or nothing to do. In other words, we in America had nothing to take the place of wartime flying. Meanwhile, Europe forged ahead in commercial aviation. Although we were the first to introduce winged mail, Europe has eclipsed us beyond a doubt. And Europe has done remarkably well in commercial aviation. We are a considerable distance behind, true; but it is with some satisfaction that Americans at last can rest assured that a start has been made in American commercial aviation, and that a practical way has been found to make such ventures profitable. This is the story which we have asked Mr. d'Orcy, a well-known authority on American and foreign aviation, to tell our readers.*—THE EDITOR.

A SIGNIFICANT ceremony took place a few weeks ago at the Columbia Yacht Club, on the Hudson, in New York City, when Rear Admiral Glennon, commander of the Third Naval District, raised the American flag on two large Aeromarine flying boats constructed for a daily mail and passenger service between Key West and Havana. This act truly marks, as Charles F. Redden, president of the Aeromarine Engineering and Sales Company, remarked in his inaugural speech, "The first constructive step in the history of American rapid transportation toward the creation of regular passenger air lines such as are operating in Europe with marked success."

Although the first country to start the operation, in May, 1918, of regular air mail services, the United States was later outstripped in commercial aviation by England and France, in which countries numerous passenger air lines have been organized since the armistice. America's tardiness in taking advantage of the latest means of rapid transportation may in part be justified by the fact that while the British and French Governments accord various kinds of direct or indirect financial assistance, until recently nothing of the sort was forthcoming from our own Government. Lately, however, the Post Office Department decided to supplement its own air mail routes by letting out contracts for the carrying of mail by privately owned aircraft.

This commendable policy affords air transport firms just the kind of indirect financial assistance they require for making commercial air service a sound business proposition, and the organization of the Key West to Havana air line is its first practical result.

It may be asked why air transport companies should require government assistance. The reply is that the organization of "airways"—as commercial air services are now referred to—demands a considerable capital outlay, firstly, because of the extensive "ground organization" required, and secondly, because at the present time airways can be made commercially sound only if a certain amount of pay load is guaranteed. Just as the merchant marine could not operate its ships without adequate harbor facilities, no airway can be run without airports, emergency fields, fuel depots, repair shops, aerological and radio stations, etc. Now all this ground organization hardly exists in this country, whereas in Europe the governments have undertaken this work as a matter of public utility.

On the other hand, the problematic nature of the pay load is due to the fact that the "aerial traveler" represents an economical factor that has yet to be created.

This is what the Aeromarine West Indies Airways set out to do when they decided to carry passengers in addition to the 500 pounds of mail they are under contract to transport daily between Key West and Havana. The service is operating with a fleet of six twin-engine flying boats, three of which bear the names of Columbus' caravels—"Santa Maria," "Pinta," and "Niña." This type of commercial seaplane was developed by the Aeromarine Plane and Motor Company of Keyport, N. J., from the famous "F-5-L" class of naval aircraft which the United States Navy produced during the war in response to the German submarine menace. Owing to their large carrying capacity and reliability, these flying boats were able to carry important loads of bombs over great distances and thus became largely instrumental in clearing the Allied sea lanes from enemy underwater craft. Since the armistice an "F-5-L" seaplane established a new world's endurance record by remaining in the air without alighting for twenty-four hours and nineteen minutes—a performance which will give the reader an idea of the possibilities of these machines.

The reconstruction of the "F-5-L" type into a mail and passenger carrier consisted mainly in reducing the fuel capacity from ten to four hours and in equipping the hull with two comfortable cabins seating six and five passengers, respectively. The cabins are situated one forward and one aft of the wings and are furnished with comfortably upholstered reclining chairs from which the passengers can gaze upon the underlying panorama through regular portholes fitted with curtains. Altogether the accommodations are fully comparable with those one expects to find on a large sized motor boat or in a limousine. A passageway inter-connects the cabins, which are reached from the deck through two hatches. A sliding door furthermore allows direct access to the after cabin.

Amidships, and raised over the roof of the cabins, is situated the contral cockpit, which can accommodate a crew of four men and holds a dual control set, the necessary instruments, and a radio outfit with a two-way range of 50 miles.

The weight of such a flying boat, fully equipped and including the water for the radiators (226 pounds) and emergency provisions, but excluding fuel, oil, crew and pay load is apportioned as follows:

| | Pounds |
|---|---|
| Hull and fittings | 2,340 |
| Wing and tail structure | 2,613 |
| Machinery | 3,136 |
| Navigational | 150 |
| Radio | 160 |
| Electrical | 57 |
| Total | 367 |
| Total net weight | 8,456 |

**The "Santa Maria," another of the flying units of the Key West to Havana air line**

(*Continued on page 555*)

## A Canoe That Travels Over Roads

AT the recent canoe regatta held in Grunau, Germany, not so long ago, the canoe-automobile shown in the accompanying illustration attracted no little attention. This machine is nothing more than a standard canoe mounted on light automobile chassis. Holes have been cut out of the bottom of the canoe in order to bring through the steering post and dashboard connections. The emergency brake and the gear-shift levers have been left outside, in accordance with the standard European practice. All in all, this may be called a canoe which travels over roads, for it is still a canoe so far as shape and seating arrangements are concerned.

**These German watermen have mounted a canoe on a light automobile chassis**

## Glass Windows for the Salvage Pontoon

DAY by day we learn of something new in the way of salvaging equipment and methods. And naturally enough, for never has there been so fruitful a field for the imaginative mind and the inventive genius as at present, when the seas are liberally dotted with wrecks which await the operations of enterprising salvagers.

From Denmark comes the accompanying view, showing a pair of aluminum pontoons equipped with glass windows. An interior chamber runs the entire length of these cylindrical pontoons, which are pointed at each end. A portion of each pontoon is provided with stout planes of glass, which, presumably, are of sufficient strength to resist the heavy pressures brought to bear on them by water at even small depths. The occupants of these pontoons are provided with powerful electric lights so that they can see the progress of the work under water, and direct the divers in attaching hawsers and doing other tasks. The lifting power of the pontoons, which must be considerable, is also depended on for raising the sunken object.

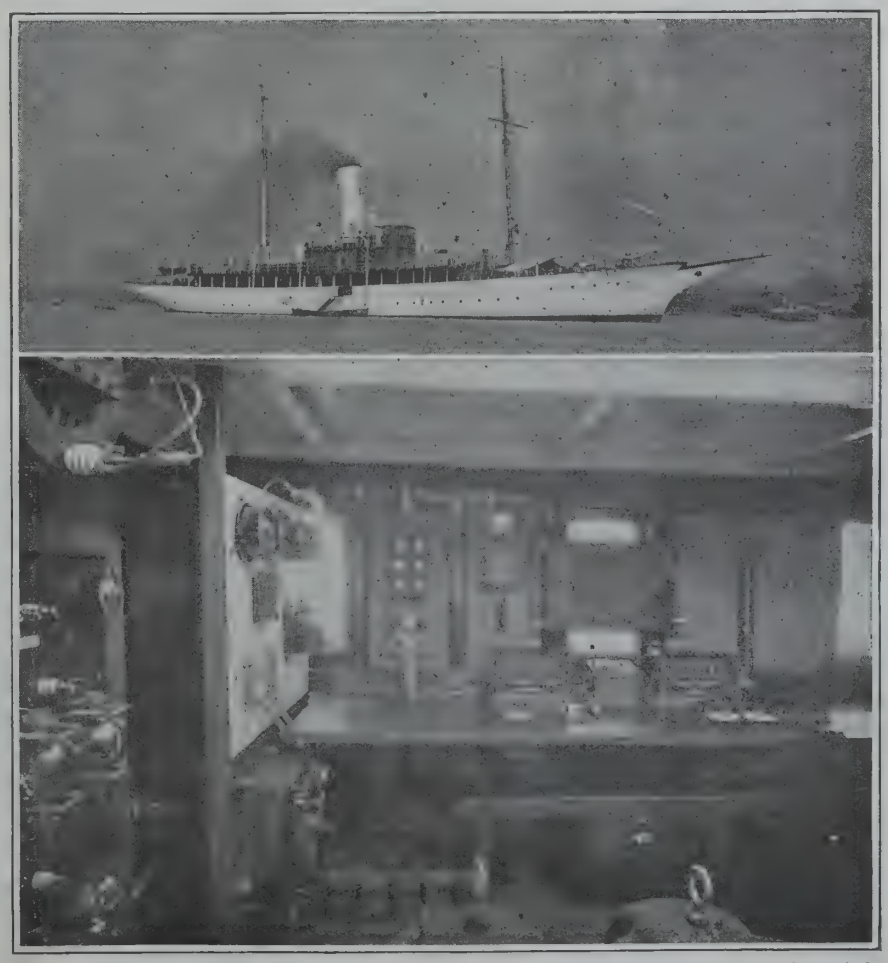
**Glass-sided pontoons that have been constructed in Copenhagen Harber for certain salvaging operations**

## Marconi's Floating Laboratory

MARCONI, as a great inventor, runs true to form: he is indefatigable in his researches and improvements and new ideas with regard to radio communication. Not content with having laid the foundation for practical wireless telegraphy, he has continued year by year in the marvelous development of radio communication.

In this connection the yacht "Electra" is of cardinal interest, for it is aboard this private vessel that Marconi does much of his research work. Our two views show the yacht and the wireless laboratory aboard it. A vacuum tube transmitter for undamped wave transmission, suitable for radio telegraph and telephone messages, appears at the extreme left, followed by a power switchboard. The long table contains vacuum-tube receiving and amplifying apparatus, as well as delicate instruments for making quantitative tests of the received signals. In the center foreground may be noted the very tops of a motor-generator set.

We have it from British sources that Marconi has recently been experimenting with radio transmission and reception of extremely short waves, which can be reflected by means of special reflectors in very much the same manner as light waves. The famous inventor is said to be experimenting with a view to using these short radio waves in foggy weather, when one ship can detect the presence of another ship by picking up these short waves and getting the direction of their source. The receiving device will be in the nature of a rotating mirror, which will stop when radio waves strike it head on, thus giving the direction.



**The steam yacht "Electra" and Signor Marconi's radio laboratory aboard it**

## Utilization of Refuse Slate

RECENT developments in the recovery and utilization of waste slate have led to the extension of processes for the production of paints, distempers, putty, brick, blocks, slabs, tiles, mortar, plaster, flooring, rubber, and molded goods. A firm in North Wales now claims to be able to build and decorate a house with slate waste, with the exception of woodwork, glazing, ironmongery, and plumbing. An article which appeared in a recent issue of the *Stone Trades Journal* contained the following particulars:

To find a use for the slate waste of the quarries is a problem that has occupied the minds of those interested in the slate industry since slate superseded tiles as the roofing material, which is upward of 300 years ago; but at no time has this subject been of so much importance as it is likely to be in the very near future. The slate trade is at present booming, but the boom is not likely to be everlasting. When things slacken in the building industry and when foreign competition has again to be met, prices are likely to drop from their present high level, and an outlet for the waste of the quarries would go far to assist the owners to stand the reduction. It has also to be borne in mind that the rock in many of the important quarries is deteriorating; this is a very serious matter for the quarry owner, and has increased the cost of working considerably.

At different periods efforts have been made to utilize the waste. It has been tried as a road-making material, but was not a success, roads made with slate being very dirty in wet weather. However, there seems to be no reason why it should not be used as a binder in the form of chippings, of which there is a scarcity in the country and for which there is a ready sale at a fair price. It should make a good binder for granite macadam, either tarred or untarred. It has already been tried in brickmaking and is again having a trial as such. A test made some time ago for strength and absorption between a brick made with slate dust and one of the best blue bricks showed the slate brick to be the stronger and exactly equal to the blue brick in absorption of water. Price was the consideration which killed the possibility of making slate bricks before, but at present this should not be the case.

An attempt was also made to find a market for the waste in the form of drain-pipes, and some of the pipes may yet be seen which had as their foundation slate dust. In the manufacture of cement it is claimed slate dust is excellent; and in the slate-quarrying districts a mastic made of slate dust and oil has frequently been used for leaky roofs, the mastic when set being harder than the natural slate.

The endeavor of a North Wales company to work the slate-dust business in the Bethesda district on a large scale is fairly well known in the trade, and its experiment is being watched with interest and copied on a smaller scale by a few. There is a very big demand for slate dust ground to a fine powder, and if it can be so ground at a reasonable cost there is every prospect of the business developing considerably.

## An Apple Warehouse of Hay

A SERIOUS shortage of cars, in combination with the biggest apple crop the Pacific Northwest ever had produced, led to an acute situation in Oregon and Washington last fall as the season of frost danger approached. With applies worth well over $2 a box, storage became a very serious problem.

Various makeshifts were resorted to. Church basements were filled with apples, while other church buildings not in use were filled to the roofs. Unoccupied business premises in the apple towns were hired for storing purposes. But perhaps the most interesting device was adopted by a resourceful apple grower at Omak, Washington, who couldn't get cars in which to ship his apples and simply had to devise some kind of efficient storage or suffer a heavy loss.

In his dilemma he remembered that hay has high insulating quality, and that in the baled form it lends itself readily to manipulation. He bought 150 tons of hay, and with it constructed the four walls of a warehouse. On top he put a roof of more prosaic materials. Into this his boxed apples were placed.

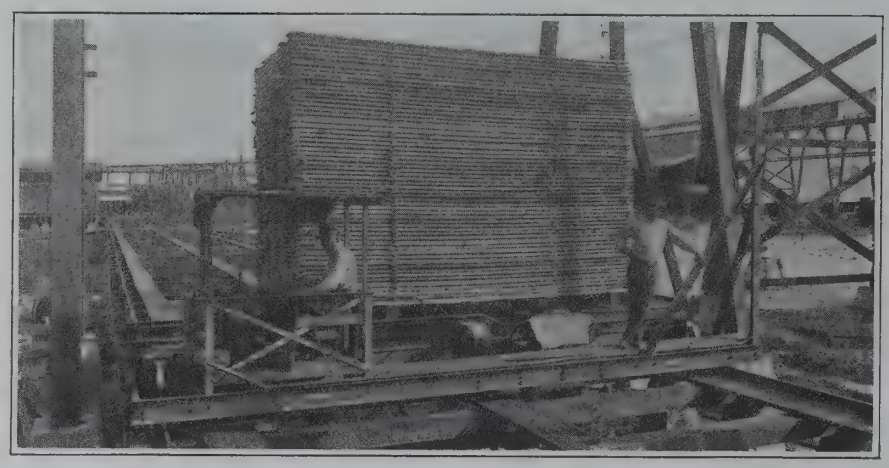
The ingenious apple man declares that his hay warehouse has answered the purpose in every respect.

# In the Modern Sawmill

## Machines and Methods by Which the Cutting Up of Logs Is Put on a Basis of Extreme Economy

By Harry A. Mount

WHERE is the man who, standing in a great modern sawmill and watching the panorama before him, has not marveled at the ease and facility with which a giant of the forests is converted into the lumber of commerce? There is something genuinely fascinating about the crash and whir of the great saw as it slashes through a mighty tree trunk with unbelievable swiftness. And in the whole lumber industry, not excepting the woodsman himself, there is no more picturesque figure than the head sawyer as he rides back and forth on the log carriage past the whirling saw, controlling this mighty display of power by a movement of his hand.



An electric transfer table with load of lumber

A visitor at a modern mill will not fail to be impressed, too, with the small number of employees required to turn out hundreds of thousands of feet of lumber a day and with the economy that everywhere is evident. It is said that the meat packer finds use for every part of the pig except the squeal. The pig is lucky compared with the log that passes through this mill, for even the sawdust and scraps are burned under the boilers which generate power.

The most surprised visitor of all, no doubt, would be the man who is familiar with the sawmills of ten years ago. The demand for timber has grown apace in the past few years and the lumber industry has made rapid strides in the improvement of its production methods.

In the early days the power employed was that of oxen or horses, or water from a nearby stream. A familiar sight near a lumber mill was a yoke of oxen dragging a load of logs to the saw. Later the ox and horse were superseded by the power of the steam engine. Today the largest and most modern mills of our Pacific slope and in the Southern pine belt, are electrified, and instead of the maze of belts and shafting, a few small wires enclosed in iron pipes, carry the power needed to cut up the big logs. How much this has added to efficiency may be judged from the fact that the electrification of one Southern sawmill recently resulted in a 20 per cent increase in output without the addition of a single machine or employee.

As an example of the amount of power required, one mill on the Pacific Coast which has a capacity of 500,000 feet a day, uses over 350 electric motors totaling in excess of 6,000 horse-power.

Transportation is undoubtedly the most important single factor in lumber production for the lumber must be carried from the lumber camps to the mills, from one machine to another and finally must be carried away from the mill. It is interesting to note that in the case cited above about 75 per cent of the installed capacity in motors is used for purposes of transportation. A trip through this mill will give a general idea of a modern sawmill.

The lumber is floated to the mill from the logging camps, several miles away, by river. The logs are pulled from the water by cables, attached to electric winches and are piled on an unloading dock. As needed in the mill they are rolled into a steel trough, at the bottom of which runs an endless "bull chain." Spaced every few feet are steel hooks or "dogs" which grip the log and carry it along and up an incline into the mill. As the log passes up the incline it goes through a shower bath of high pressure water, shot at it from all sides to remove dirt and stones, which might injure the saws.

At the top of this incline the logs are "kicked" off the conveyor by pneumatic arms and roll on to an incline, down which they slide by gravity into the log carriage. This carriage shuttles back and forth past the "head saw" or main saw and at each trip a big slab of the log is sliced off.

The head saw deserves special attention. Instead of the enormous steel disk that we might expect, we see a huge band saw. The saw blade is about a foot wide and it passes over large wheels, one overhead and the other beneath the floor. Although we cannot see, it is driven from beneath by a great electric motor of 250 horse-power, but there is evidence of resistless power in the businesslike snarl of the saw as it eats its way rapidly through huge logs.

Just in front of the "head saw" is a smaller circular saw, which merely cuts a slot through the bark. It is called the "rock saw" and its function is to dig out imbedded rocks from the bark which might otherwise do serious damage to the expensive head saw. Pipes from a motor-driven blower carry the sawdust away, unseen, to the fuel bin.

As the slab from the log falls off, it alights on a chain of "live rolls" or motor-driven rollers, which carry it away and deliver it to the "edger" where, at the will of the operator, the slab is transferred to the machine by means of trip skids. These skids are raised by a cylinder, the valve of which is operated by an electromagnet and push button within easy reach of the operator.

The "edger" consists of an arbor on which is mounted two circular saws and as the slab is pushed through these it is sawed to the desired width. The slabs may go, instead, to a "slasher," which consists of an arbor on which any number of saws may be mounted, and upon being forced through them the slab is sawed into any number of boards. The log may be sawed into planks by these machines and these planks sent to the gang saw. This consists of a number of straight saws with a vertical reciprocating and oscillating motion, which split the plank into boards of the desired thickness.

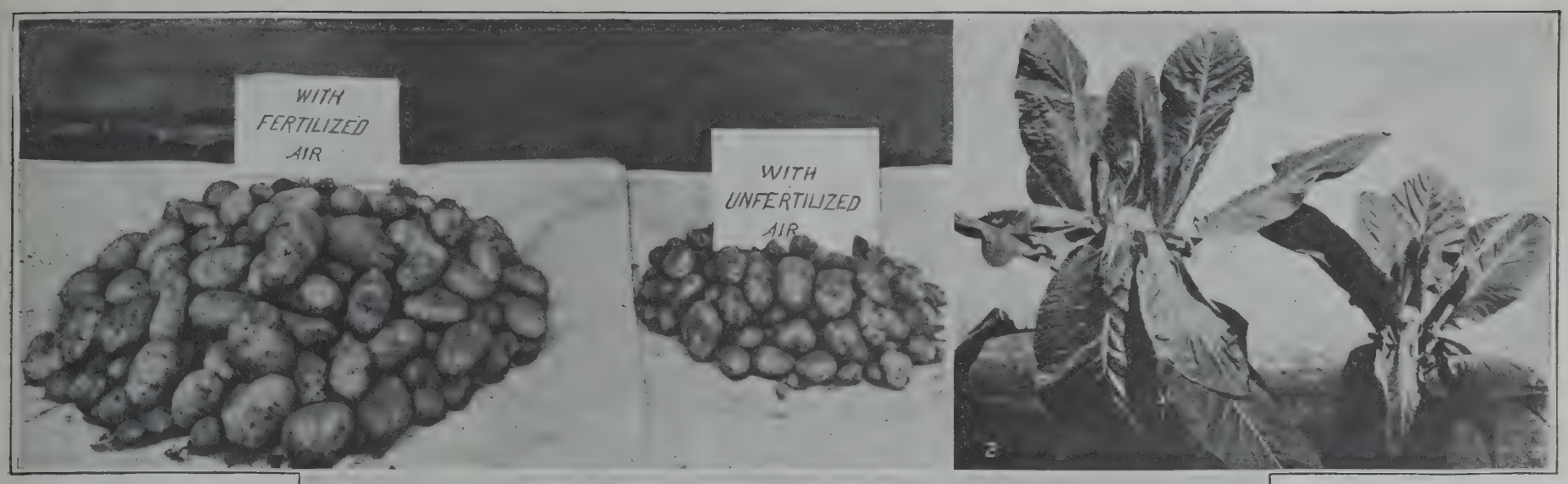
Some of the boards pass through trimmers and others go to a resaw machine to be brought to the proper thickness. A system of live rolls does all the transferring from machine to machine and at strategic points are located "jump" or "swing" saws for cutting the boards to proper lengths.

The lumber all finally comes to a "sorting table," where by a rather complicated arrangement of rolls and chain conveyors, the lumber is sorted. From the sorting table the lumber is taken by transfer cars to automatic stackers, and thence to the dry kilns. From the kilns the lumber goes to the yards, where electric trucks and tractors, transfer cars, and

(*Continued on page 557*)

1. Loading logs on the log carriers. 2. The pony edger which trims slabs down to the desired width. 3. Eleven-foot band-mill or head saw.

Some of the big machinery of the modern sawmill




1. Yield of potatoes in fields over which the air was fertilized with carbonic acid gas and left unfertilized. 2. A similar comparison for cauliflower plants. 3. An open-air carbonic-acid fertilizing plant

**Fertilizing the air with carbon dioxide to promote plant growth**

## Carbonic Acid Gas to Fertilize the Air

**By Dr. Alfred Gradenwitz**

ONE of the principal constituents making up the body of a plant is carbon, representing about one-half of its organic substance. The opinion that this carbon is derived from the soil has long been abandoned, modern investigation having shown atmospheric carbonic acid to be absorbed by means of the chlorophyl or green matter of the leaves and decomposed into its elements, the carbon, in conjunction with the root sap and atmospheric moisture, being worked into organic compounds.

Whereas atmospheric air at present is relatively poor in carbonic acid, of which it contains only about .03 per cent, at an early period in the development of our planet, when this was covered with the luxuriant forests our coal deposits are derived from, it comprised incomparably greater quantities of this gas. This fact suggested the idea of heightening the fertility of the soil by increasing its carbonic acid content and thus producing conditions resembling those of antediluvian ages. In order to enable such a process to be carried out on anything like a commercial line, a cheap source of carbonic acid had, of course, to be provided.

This was found by Dr. Fr. Riedel of Essen-on-Ruhr in the combustion gases escaping from all factories, but most abundantly from blast-furnaces, and which so far had been allowed to flow out into the atmosphere without serving any useful purpose. He accordingly set to work designing a process for which patents were obtained and which was put to practical tests on a large scale. Three greenhouses were at first erected, one of which served as testing room, while the two others were used for checking purposes. The testing room was supplied with purified and burnt blast-furnace exhaust gases through a line of punctured piping traversing the whole greenhouse in a forward and backward direction. The gas supply was started on June 12th, that is to say, at a time when plant growth was at its height.

On account of the careful cleansing and complete elimination of constituents such as sulfur, the gas was found to exert no harmful effects. On the contrary, even a few days after starting the test, there could be observed in the testing room a more luxuriant vegetation than in the checking houses. The leaves of the castor-oil plant in the greenhouse supplied with gas were found to reach more than one meter in span, whereas the largest leaf in the checking houses was only about 58 centimeters in width. Plants submitted to the influence of carbonic acid gas also showed a marked advance with regard to their height. With the tomatoes planted in another part of the greenhouse a crop of 29.5 kilograms was obtained for a given number of fruits, the weight of the same number of fruits in the testing room being 81.3 kilograms, that is, 175 per cent more. With the cucumbers planted at the same time a somewhat slighter difference was noted, the yield in the checking houses being 138 kilograms, in the testing house, however, 235 kilograms, corresponding to an increase in yield of 70 per cent. An interesting phenomenon noted in this connection was that, while the cucumbers in the checking houses would exhibit bright spots, those in the testing house, on account of the more plentiful formation of chlorophyl were of a dark green color throughout.

Experiments in the open air were made simultaneously with these greenhouse tests, a square plot of ground being encircled by punctured cement pipes from which a continuous supply of exhaust gases was escaping. The wind, mostly striking the ground at an angle, would drive the carbonic acid in a variable direction

(*Continued on page 557*)

## Mechanical Stevedore That Handles Bananas

**By Thomas Ewing Dabney**

A NEW application of an old principle—which is all that invention is—has met the high cost and scarcity of labor on the wharves of New Orleans, and enabled that port to expand its trade in its most important article of import—namely, bananas. This is a handling device which transfers the fruit from shipside to the cars at an estimated saving of 2½ cents a bunch. As New Orleans imports 20,000,000 bunches of bananas a year, this means a gross saving of $500,000. Add to this the saving in time and the fact that there is less damage to the fruit by the mechanical than there is by the physical method of handling, and the annual saving will not greatly miss the million mark.

About 600 shiploads of bananas are brought to New Orleans a year. The average ship carries 35,000 bunches, which are under present conditions unloaded in about seven hours. Three machines of the type shown in the SCIENTIFIC AMERICAN of Oct. 20, 1917, lift the bananas out of the ship and deposit them on the wharf. These machines consist of 50-foot structural towers, with a base 14 by 28 feet, set upon eight wheels resting upon two transverse rails at 14-foot gage. This tower is fitted with a main boom and a plumb marine leg which reaches into the hold of a ship; the bananas are lifted out in a continuous belt of pockets held between two parallel link chains which traverse the marine leg, main boom, auxiliary boom and tower, at the rate of 125 feet a minute. The bananas are finally deposited at the foot of the tower and then lifted upon the back of laborers, who carry them to the car a couple of hundred feet away. But the bus is too fast for the stevedores. Even with 1,000 men working, the greatest number that can be economically employed on the wharves, it is not possible for the machines to work more than 40 minutes in each hour.

To avoid this 33 per cent loss in time—and because of the rapidity with which bananas ripen, especially in the summer, every minute is worth money—William Steckler, an engineer of the Board of Port Commissioners of Louisiana, set his inventive brains in motion. He studied the trolley systems by which meat, auto tires, machinery, etc., are handled in manufacturing plants, and worked out a mechanical means of conveying the bananas from shipside, after they have been delivered on the wharf by the elevator, to the cars.

He has tried it out and it has proven a success. Every banana wharf in New Orleans is to be equipped with the device as soon as it can be manufactured.

The essential features of the device are an overhead monorail of medium design,

(*Continued on page 557*)

The bananas, hung to trolleys on a monorail, are pushed forward in the desired direction, by fingers attached to the chain shown near the top of this illustration, near L-1. The system is so devised that the over-ripe bananas are given separate and speedier handling There are monorail sidings, like ordinary railroad sidings, on which the fruit is stored until it can be put aboard a car

**A corner of the banana conveyor mechanism installed at New Orleans**

# With the Engineers of Industry

*A Department Devoted to the Physical Problems of the Plant Executive*

## The Sectional Unit Factory

HOW large is a building? This question, in just this form, sounds trivial enough; but if we translate it into somewhat different terms, and ask, with the executive, "How large a building will this department require, and how large a building can be erected for it in the time and with the funds available?" it takes on an aspect of real importance. One of the most embarrassing situations in all industry revolves about this problem of factory housing. And the statement that a new type of factory construction has been developed that automatically solves the problem before it arises is of interest to every growing business.

The principle employed is that of the sectional bookcase. We all remember what a task it was to house a growing library in the old days of the rigid bookcase, and what a boon we found in the bookcase that grows with the books, and is always just the right size to hold the volumes which we have to put in it. From the designer's viewpoint, there was little to the sectional bookcase save the idea. When that idea is taken over by the manufacturer of building materials, however, the idea becomes the least perplexing detail, and a great deal of careful thought must be devoted to the working out of styles and sizes of the building units, and to the means of joining them up.

The manufacturer who features this style of construction in his catalog uses pressed steel as his basic material. The design of each part has been carefully studied in order to develop maximum strength from minimum material, and of course maximum standardization. The wall unit, furnishing the starting point, is made in various heights, and is interchangeable with door units; it is furnished with and without window frames, so that by appropriate alternation any desired arrangement of blank wall or window space can be obtained. Every field joint and connection is made weather-tight and element-proof. Through the use of a simple and practical device which makes all field connections, the buildings are erected speedily and at a low labor cost. Since they can be taken down and re-erected without replacement of any part, they have a salvage value of one hundred per cent. The removal of one of these buildings, in fact, is a process entirely analogous to the taking down of a sectional bookcase on moving day and its re-assembling in the new apartment.

The length and width of the building may be carried to any desired extreme

(*Continued on page 558*)

## The Question of Reflecting Surfaces

OF fifty-eight large steamship piers which have been inspected, 42.6 per cent had illumination which was entirely inadequate and generally poor, 51.2 per cent had fair illumination and only 6.2 per cent had good illumination. The average watts per square foot of these electrically lighted piers was 0.16, varying from a minimum of 0.05 watt to a maximum of 0.34 watt. Very much better illumination results would have been obtained in nearly every case had the equipment been well maintained and the surroundings occasionally painted with white or other light paint. Only 3.6 per cent of the piers had white walls and ceilings; 9.1 per cent light-colored surroundings, 20 per cent medium-colored, 52.8 per cent dark, and 14.5 per cent very dark, almost black, according to A. L. Powell (Lighting Service Department of the Edison Lamp Works of the General Electric Company), an authority on illumination.

The results of the better conditions in those piers having well-maintained fixtures, light surroundings and adequate illumination were (a) greater actual speed of trucking, (b) markings more easily read, (c) fewer missent shipments, (d) spoilage and theft reduced, and (e) relations with the public greatly improved.

Of course, this particular survey deals with piers, but is it any different in the average factory? Black or dark walls mean the absorption of useful light which might otherwise be turned to some real work. There are many suitable paints on the market with highly reflective qualities which serve to distribute both daylight and artificial light into every corner of a large plant. There are numerous styles of fixtures which make for the maximum illuminating efficiency. But all these are of little use if permitted to discolor or become heavily coated with dust, since their efficiency is reduced in direct proportion to their departure from absolute cleanliness.

## The Matter of Steam Pipe Insulation

NO engineer would think of using bare wires for carrying heavy electric currents: he would insist on their insulation. Yet there are cases almost without end where plants which are held up as models of efficiency, use steam pipes that are not insulated in the proper manner. And just as electric current would leak in the instance of uninsulated wires, so do heat and steam leak or become weaker when carried through uninsulated pipes.

There is no excuse for uninsulated steam pipes at this time when, on the one hand, coal is selling at exceptionally high prices, and when, on the other hand, fuel engineers have made such a thorough study of heat insulation. Two symptoms, we are told by heat insulation engineers, always signal heat loss from a steam pipe. One is lowered pressure in the pipe, the other is high temperature of the air surrounding the bare or poorly insulated pipe. Obviously, this falling pressure or surrounding heat means that fuel in the form of heat is being wasted. Pipe insulation is necessary.

An insulation to be of maximum value must have more than the property of preventing heat loss. It must also have physical durability, for a short-life material means early replacement, so that if insulation values are equal, the most durable insulation is the most economical. A number of heat insulating materials are now on the market, and companies producing these materials have a staff of engineers who specialize in problems of this kind. Both indoor and outdoor installations, overhead and underground, and every other condition can be met by consulting the heat-insulating engineers.

## Spraying Paint for the Sake of Morale

AS someone has aptly put it, what a big difference the proper application of a little paint makes. Light, cheery, sanitary and thoroughly protected factory walls and ceilings benefit both plant owner and his men to an immeasurable extent. That is a different angle to the paint problem already covered in another item in this department.

But the accompanying big paint and labor bills, where costly, deficient painting methods are employed, are out of all proportion to the benefits derived. Again, in most plants the paint does not remain clean and fresh for any length of time, hence painting must be done at regular intervals.

Just here is where spray comes into its own. Any one of the several types of portable painting equipments now available makes possible four or five times faster work than can be done with the old-style paint brush. All coats are applied more thoroughly and uniformly on every part of the surface, insuring a longer wearing and greater light reflecting surface. The need of scaffolding is saved in many places. The men are enabled to work with less fatigue and to leave the surroundings in cleaner condition. The outside and inside work is done equally well with any kind of paint, requiring no more than when brushing. But why go on? The spray method of painting is unquestionably a vast improvement over hand method for such work as we have been discussing.

## A Rival of the Steam Whistle

IT may be that the steam whistle in time will be a matter of past history; at least, the steam whistle is steadily losing ground in favor of the electric siren, which has proved considerably more efficient in more ways than one.

In industries large and small, in mines, factories, foundries—wherever a warning signal with greater range and more distinction in tone than the steam whistle is required—the electric siren has been found to fill a long felt need. The electric siren is clear, unmistakable, most distinctive. It cannot be confused with any other sound. While a boiler full of steam is needed for the steam whistle, the electric siren may be operated from any number of places through the factory by a simple turn of the switch. It is always ready, dependable, fool-proof, insignificant in upkeep cost. The electric siren can be either large or small—large enough for the largest works, and small enough for use in any department of such works, where it must signal through the noise and din of incessant toil and bustling activity.

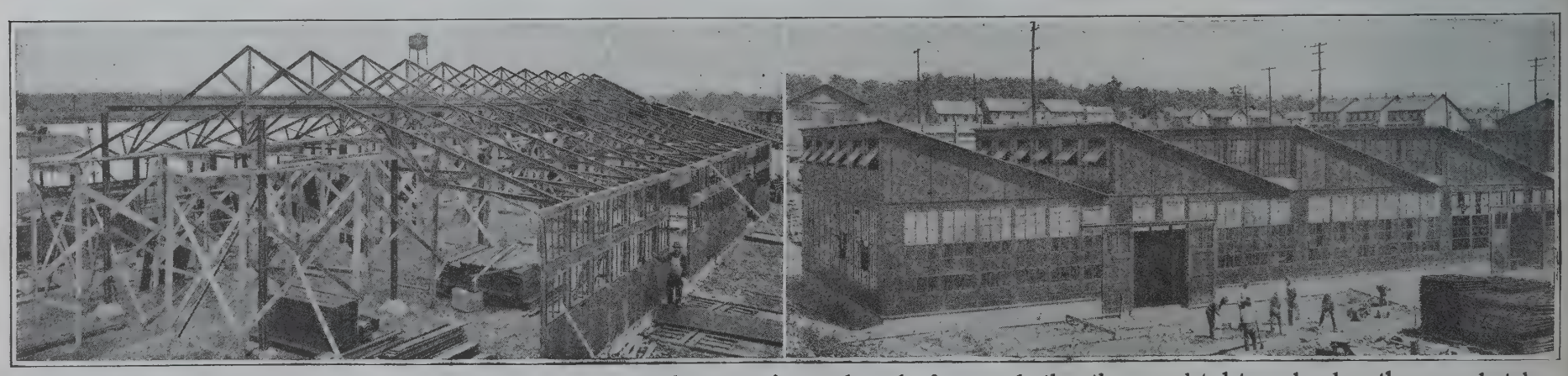
## A New Idea in Factory Heating

THE very expansiveness of the average plant often renders the usual systems of heating somewhat faulty and inadequate. The heat is not distributed through the large bays, because there is no way of getting it into circulation.

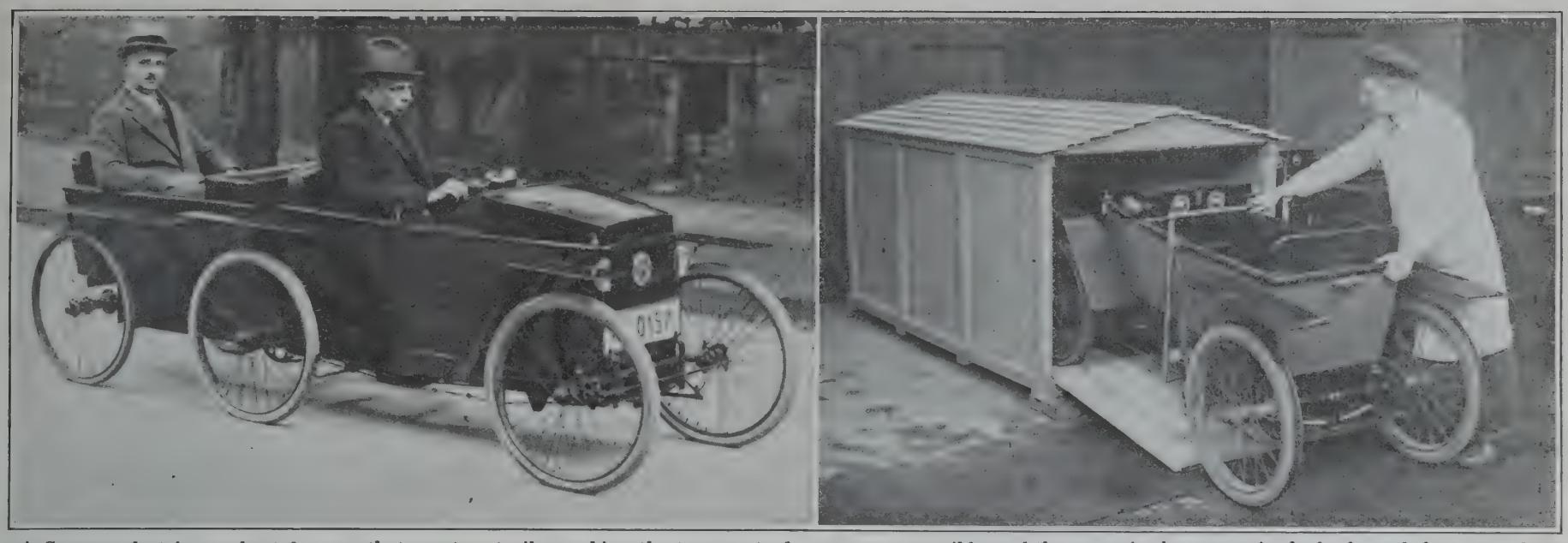
With a view to getting heat to every part of the largest factory bay, one concern has developed a heating system which is claimed to heat the factory to the same comfortable, uniform degree. No matter what the weather conditions, type of building, construction, size of space to be heated, and other factors, the new heating system is said to heat all of the open space, so that remote, far-off corners will be equally as warm as the area immediately surrounding the heater.

To get down to specific details, the heater is a compact, self-contained unit which requires no pipes or ducts for air distribution. Installation cost is 15 to 50 per cent less than other types and

(*Continued on page 558*)



**Sectional factory buildings of pressed steel units, one in course of construction to show the framework, the other completed to make clear the general style. In the latter, the individual units can be easily identified, and give some idea of the flexibility of this construction**



**A German electric runabout for one, that sports a trailer making the transport of a passenger possible, and that occupies less space in the back yard than some dogs**

## The Electric "Klein-Automobil"

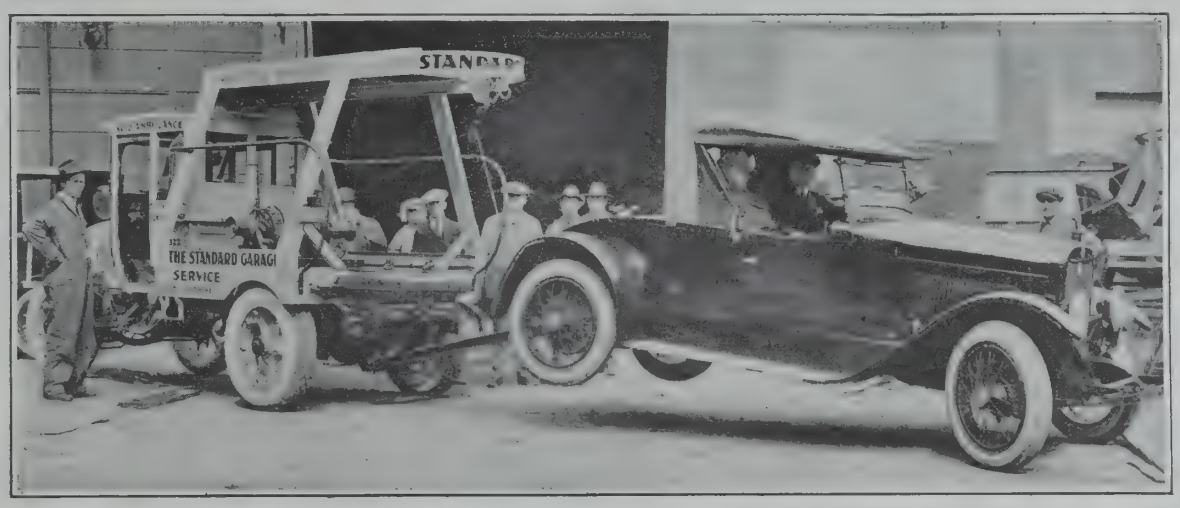
ON a recent motor trip between New York and Delaware Water Gap, we pronounced the main street of the largest town between Morristown and the Delaware to be the worst bit of road we had ever met; and we have heard of cars wrecked by the rough going on the Liberty Highway between New York and New Brunswick. When such things as this are possible, it is evident that the "small car" of song and story is the smallest and lightest vehicle that we can hope to employ on American roads for many years.

In Europe, on the other hand, road conditions are very different. There are literally thousands of miles of highway, fairly honeycombing Britain and the western part of the Continent, on which anything heavy enough to give itself traction will ride with speed and smoothness. Hence there is a large field for something that shall really be a little below the class of the true automobile—something that shall weigh a fraction of a ton only and make anywhere from 60 miles upward on a gallon of fuel. The existence of this field is daily attested by evidence both of production of such vehicles and of demand for them.

It now appears that the manufacture of these little runabouts is not to be confined to the gasoline system of propulsion. One of these tiny baskets on wheels, now being marketed by a German company, derives its power from batteries. The car is made in one model only, a one-passenger runabout, with wheel-base 57.12 and tread 33.45 inches. The weight is 440 pounds, which makes the suggestion of our picture, that the proprietor is picking his car up and tucking it away in its minute garage, not quite so absurd after all. To it can be attached the two-wheeled trailer for an additional passenger shown in our other view; or for this may be substituted an auxiliary of different style for delivery purposes.

Electric current is furnished by two 24-volt lead-plate batteries of 6 cells each, located in the forward part of the car. These require 2½ kilowatt hours for a full charge, which will drive the car about 35 miles in Berlin, where the streets are well paved and have fewer grades than in the average city. The electric motor develops about 1½ horse-power and permits a maximum speed of approximately 13 miles an hour. The motor is set well back in the frame, very close to the rear axle. The power is transmitted by a chain to a jack shaft set forward of the motor, and thence by a single chain to the right rear wheel. This use of a single driving wheel obviates the necessity of a differential.

The car is quoted at 13,000-14,000 marks and the trailer at about 4,000 marks. If it is not wholly clear that these are one-cent marks of the vintage of 1920, the quotation of 2,550 marks for a reserve battery ought to make it plain that this is the case, and that anyone who is in a position to apply real money to the purchase of this vehicle will get it very cheap. We are informed that the company has a present capacity of 100 cars per month, and that already 300 of the vehicles have been delivered and put into use.




**If the damaged car can be salvaged, this wrecking outfit will do the trick**

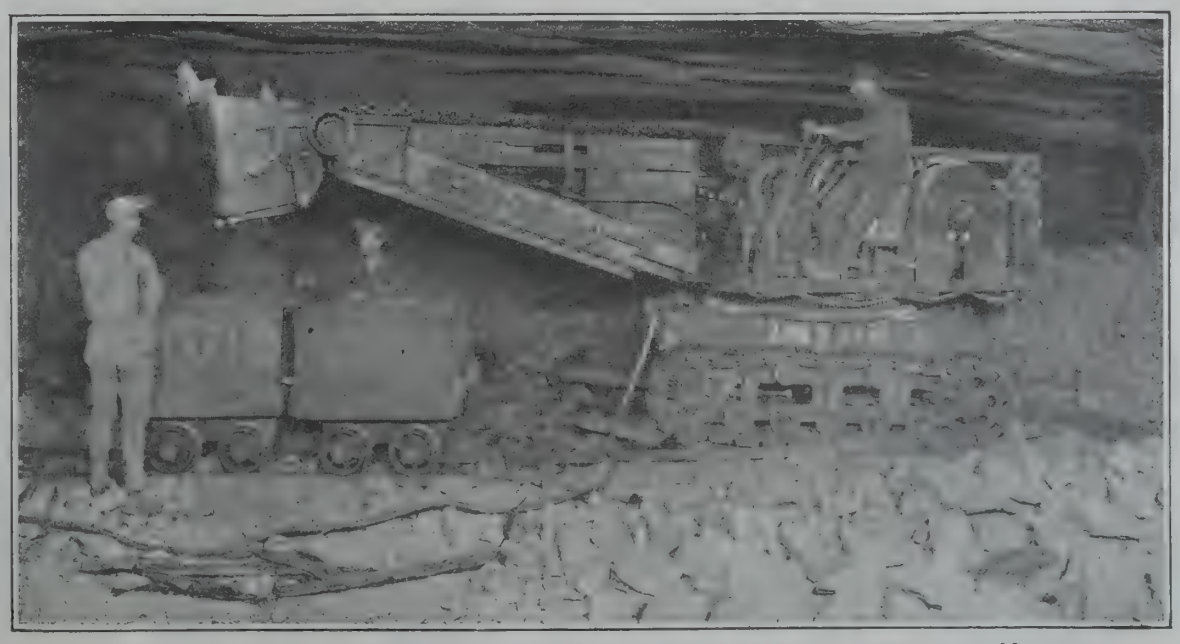
## First Aid For the Crippled Car

WE illustrate an admirable automobile ambulance which is in service at a Toledo garage, and which is of such evident all-around utility that it is difficult to imagine any case of a sick car which it could not treat — barring, of course, that the patient were totally defunct. The designation "automobile ambulance" is one given the new outfit on the basis of its performance, and one which it readily can be seen to deserve. Not at all cumbersome itself—its foundation is a 1½-ton chassis—it is able, with one man at the winch, to lift easily cars weighing in the neighborhood of five tons. Another feature of material value is the ability to pick up a car from the rear without damage to fenders, tank or body. This has always been difficult when a rear wheel or axle was damaged and the crippled car had to be moved to shelter.

## A Lilliputian Mining Machine

WHEN labor costs at a Missouri lead mine reached a point that made it necessary to consider the designing of a machine that would combine the digging and loading functions and that would not exceed 7½ feet clearance, it might have been supposed that this problem had no solution. A Lorain, Ohio, company undertook the construction of such a machine, however.

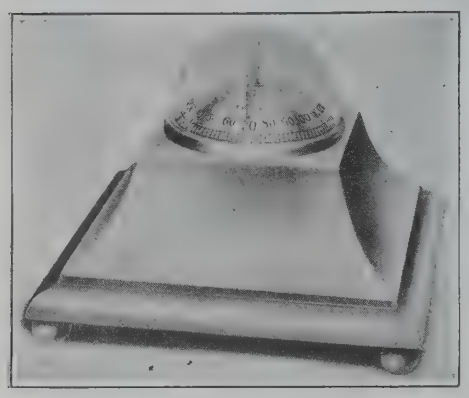
The machine consists of a rotating turntable which carries all the mechanism, and upon which is mounted the boom structure. The whole is carried by a truck frame operating on caterpillar treads. The machine is capable of digging and loading at any point in the circle. It is self-propelled and power-steered, so that it can be readily moved about in the mine. Provision is made at the point of the boom for raising the boom sheaves in the event that excess dumping height is required. The performance of this machine shows a cost per ton of material delivered to the shaft that runs from 5 to 20 cents, as against a previous cost with hand labor of 25 to 60 cents. Its normal operating speed is three digger loads per minute, with a crew of two or at most three men.



**A mining machine that digs and loads in a drift into which ordinary apparatus could not go**

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*



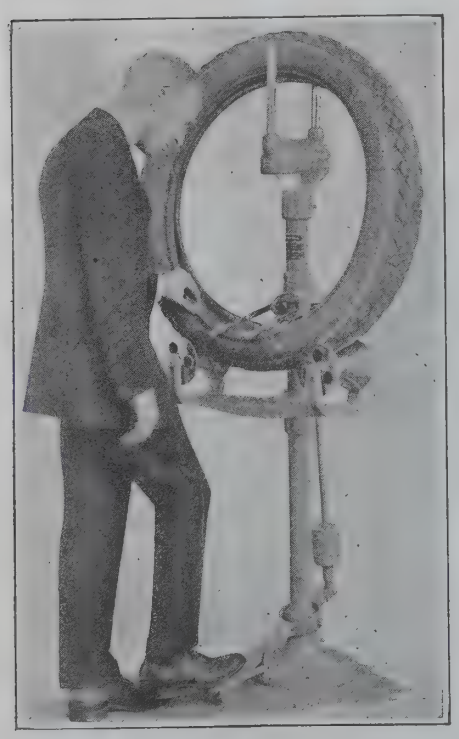
**A small flag swings around to indicate the temperature in this office desk thermometer**

## When a Small Flag Tells the Temperature

THE small flag mounted in the center of the office desk thermometer, shown in the accompanying illustration, swings around at the slightest breath and tells the temperature. The raised dial around which the flag travels is graduated like the face of a watch. So sensitive is the device that the slightest draught will send it on its way indicating the change. Not much thought has ever been given to the average temperature indicator, but in this recently patented design beauty has been added to accuracy, making an ideal combination.

## Finding the Small Breaks and Cuts in Tires

TIRE repair men do not depend upon their hands and eyes in the inspection of tire tubes with a new machine shown in the accompanying illustration. It opens and inspects the stiffest tire in ten minutes. The entire surface of any sized casing may be readily seen. It is then inspected thoroughly under a powerful concentrated light. All the small breaks and cuts which are generally at the bottom of much tire trouble may be found easily. It tells the unvarnished truth about your tire, so to speak.

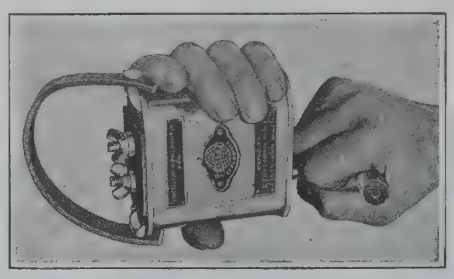


**The inspection of tires becomes a simple and positive job with this machine**

## A Pocket-Sized Electric Blasting Machine

WITH the blasting machine shown in the accompanying illustration, all that is necessary to fire the charge is to turn the key at the bottom of the electric blaster as far to the right as it will go. One turn is sufficient; and the key can be removed and carried in the pocket of the man in charge of the blasting, insuring absolute safety. The leading wires are connected to the binding posts of the blaster. It is light in weight and can be carried about easily.

It should be obvious that this little blaster is only intended for the firing of a few charges at a time. In fact, it has been developed by a powder company for the use of farmers and small contractors whose modest needs would make a large blaster a luxury, so to speak.



**One twist of the handle serves to operate the small electric blasting machine**

## Packing of Dyes, in Powder Form, for Dispatch to Foreign Countries

THE following regulations have been issued by the United States Post Office Department regarding the packing of dyes, in powder form, for shipment to foreign countries:

Dyes, in powder form, must not be accepted for transmission in the parcel post mails to those foreign countries admitting dyes in the parcel-post mails, except those dyes packed in a tin or metal container and such container inclosed in a substantial outside cover, open to inspection, of fiber board or similar material, double-faced corrugated cardboard, or strapped wooden boxes made of material at least a half inch thick.

The inside tin or metal container must be one closed with a screw-top cover having sufficient screw threads to require at least one and one-half complete turns before the cover will come off, the cover of which must be provided with a washer, so as to prevent possible sifting of the contents.

This provision for the employment of screw-top tin or metal containers does not prevent the use of compression (friction) tin top or metal containers, if soldered in at least four places, or the use of lead-sealed tin or metal containers, provided the containers are labeled in printing so as to show the nature of the contents, the quantity, and the name of the manufacturer or dealer, and, in addition, the containers are inclosed in substantial outside covers, open to inspection, of fiber board or similar material, double-faced corrugated cardboard, or strapped wooden boxes made of material at least a half inch thick.

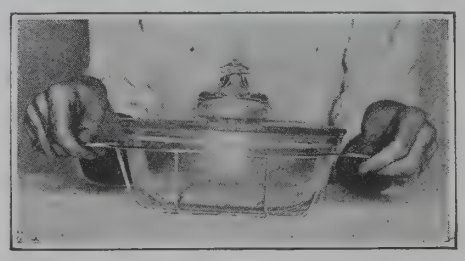
Acceptable packages of samples of dyes, in powder form, not exceeding 12 ounces in weight, and packed in accordance with the requirements of the Postal Union regulations, will likewise be received for transmission in the international parcel-post service, when postage is paid at the rate of 12 cents a pound or fraction thereof.

## Still Another Scheme for Harnessing the Wind

EUROPE is facing a serious shortage of fuel of all kinds. Coal, gasoline, wood, alcohol—all these common forms of fuel are lacking. In consequence the inventors of numerous countries have turned their attention to the power and heating problem, and many strange things have been suggested and tried out.

Among the many new ideas is the vertical wind mill shown in the accompanying illustration. This is a French invention, and it is reported to be quite satisfactory where the prevailing winds are more or less constant throughout the year. Among the advantages claimed for this form of vertical windmill or wind turbine are: Power no matter in which direction the wind is blowing; noiseless operation; the windmill does not have to turn about to face the wind, hence no loss of time; no danger of damage from strong winds or gales; five times the power derived from the usual forms of windmills; no mechanical upkeep or operating expense. The inventor is ready to undertake the building of such windmills in all capacities from ½ to 100 horse-power and over.

In order to take care of fluctuating winds, the windmill is employed in connection with an electric generator and storage battery. In this manner the mechanical power is converted into electricity and stored away until required. However, the inventor assures us that the windmill operates in practically any weather, and that only a few days are really lost throughout the year.



**The hot glass dish may be readily and safely handled in a wire frame**

## An Ounce of Wire Prevention

IT has not been long since glass was first introduced in which to make pies and other tempting dishes for the table. Our grandmothers, a few years ago, would hardly think such a thing possible— to bake in glass in place of tinned or enameled iron and crockery.

However, glass is coming into such general use that a manufacturer of wire novelties has conceived the idea of making wire frames into which these glass accessories of the kitchen may be placed while in the oven. The ounce of prevention is this. Hot glass dishes are hard to handle. Frequently when they are brought from a hot oven and placed upon a cold surface, they will crack. With the new wire frames both of these objections have been overcome.

As we have often pointed out in these columns, it is such inventions as this one which meet with a ready market. Indeed, there is a tendency to overlook the simple things in inventing; yet it is the simple things that usually take best.

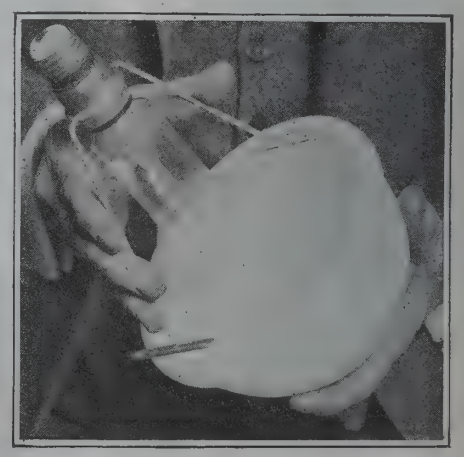
Copyright Keystone View Co.

**This French windmill may be built for any power from ½ to 100 horsepower, depending on the size**

## Could Anything be Simpler than This Lamp Bowl?

IT is certainly uncomfortable for the eyes to work before an unshaded incandescent lamp. Eye fatigue results, and if the practice is continued for long periods of time, the fatigue must necessarily extend to other parts of the body. At any rate those who make a special study of shop accidents tell us that fatigue causes men to become careless, and that most of the accidents occur between the hours of three and four.

Improper lighting is the greatest cause of eye fatigue, and despite the many advances made in improving working conditions in our shops and factories, one often finds no provisions for safe-guarding the eyesight of the workers. Reflectors cost money, to be sure, and their installation is often overlooked because of the expense and trouble involved. But the invention of a simple reflector and holder, recently placed on the market, removes the objections of trouble and expense. Indeed, so simple is the combination of the wire holder member and the translucent bowl that there is no excuse for failing to shield incandescent lamps in this manner. The shade or bowl may be snapped on or off for cleaning purposes, and the holder fits any incandescent lamp.



**Any incandescent lamp can be instantly fitted with the simple holder and bowl**

## Making the Barge Canal Pay

(*Continued from page 542*)

Lake Champlain Transportation Company has 24 barges, the Murray Transportation Company has 26 barges and the Transmarine Corporation has several fleets of steel carriers in operation on the waterway. There are, in addition to these, 500 boats of the old Erie Canal type owned or under charter to industries while many corporations have from 1 to 20 barges of special design in constant operation. These latter operators include the General Electric Company, American Radiator Company, Standard Oil Company and a number of cement companies.

Some of the corporations appear to have set out to use the canal to the limit of their needs. The channel had no sooner been opened last spring than the Standard Oil barges were on their way up the canal. This company brings oil to Albany in large tank steamers and pumps the fluid into storage tanks. From these tanks the oil is pumped into the canal tankers and shipped as far north as Burlington, Vermont, and as far west as Rochester. The company has stations at nearly every point of any size on the canal and, at several places where the Standard Oil has both rail and water connections, not one carload of oil was brought in by rail during the past navigation season. Some idea as to the extent to which the Standard Oil Company is using the State's waterway may be obtained when one is told that it has expended $110,000 in constructing a turning basin at Rochester. This clearly demonstrates that this big corporation, with its array of engineers, statisticians and economists, thinks that New York's Barge Canal is a going proposition and it certainly shows that the channel is a structural success.

The General Electric Company is also shipping a great deal of its finished products from its Schenectady plant to New York over the canal. This company reports that it can bring its water shipments from Schenectady to New York in the time it takes the railroads to get a car out of the company's yards and plans have been prepared which call for the construction of a private terminal at Schenectady to handle the General Electric shipments.

Despite this and other evidence that many shippers have found that shipping by canal is a paying proposition, there is still much ignorance among shippers relative to the waterway. A Buffalo manufacturer was recently complaining that he could not get his steel products to New York City. He said that the rail lines positively could not get the goods through. He was asked why he did not ship by canal and was surprised and startled to learn that there was such a route available. This is only one instance, but it shows the need of acquainting people with the availability of the Barge Canal.

The trouble is that almost a generation of men has grown up which thinks of transportation in terms of rail shipments only. This should be changed, and if it is done these shippers will think in terms of water routes as well as rail lines. If they once begin to think this way they will find that it is greatly to their advantage to utilize the canal system. What is required to bring this home to them is a "Ship by the Barge Canal" movement and this should not be limited to the State of New York but should cover the Great Lakes, New England and Middle Western States as well.

Shippers and industry demand relief from freight congestion. Because of the present lack of carriers, many have been disappointed in their search for cargo space in canal carriers. The Great Lakes shipper demands that his grain and other commodities be moved to the ocean at the cheapest possible rate and by the shortest route. He knows that recent increases in railroad freight rates, according to his schedule of costs, have placed him just 500 miles farther away from the seaboard than he was in 1918. In other words it now costs him as much to move his freight to New York as it would have cost him to have shipped it 500 miles beyond that port in 1918. He must have relief and the Barge Canal will afford him that if he will use it; for, now that capital knows that Federal operation of barge fleets will shortly be a thing of the past, it is constructing barge fleets and many responsible carrying corporations are being formed which will not only be in a position to approach the shipper and offer him cargo space but will also present him some workable plan whereby he will be guaranteed that his cargo will reach its destination within a stipulated time. In fact, one carrying corporation now moves its fleets on a set schedule and is extending its facilities by constructing its own terminals at Buffalo and Newark, New Jersey.

The reawakened interest in waterway matters does not rest here, for merchant marine interests, aware of the facilities the canal system affords, have become interested in the channel. This has been demonstrated by the movement recently launched by a prominent group of marine men who will shortly establish a waterway association that will give shippers and canal adherents, in general, a direct service. This organization plans to bring about coöperation between shippers, Great Lakes carriers, barge lines and vessels in the American Merchant Marine. It seeks to obtain low rates on goods which are to be exported and will, through coördination, enable the shipper in inland cities to bill his goods direct to Liverpool or other foreign ports via the Barge Canal.

In the steel trade, rail freight rates from Buffalo to New York amounted to $3.90 a ton in 1919 while the canal rate was $2.50 a ton or a differential in favor of the waterway of $1.40. Authorities believe that with proper organization steel can be shipped between Buffalo and New York for $2 a ton and, in fact, the Transmarine Corporation is offering to handle steel products to Bridgeport, Conn., at a rate of $2 a ton. With rail rates 40 per cent higher this year than they were in 1919 and using the suggested figure of $2 as a basis, the canal differential on steel would be more than 50 per cent. The same condition is true of iron ore and other commodities.

The original Erie Canal was constructed before the advent ot the railroads and for over fifty years it was the cheapest medium for transporting freight. With the development of the railways, however, the canal gradually lost its advantages so, in order to hold its position various enlargements were undertaken. These conditions lasted for a time but not for long, as the railroads were also improving their efficiency and lowering their rates. The explanation for this is easy to discover, as the cost of transportation is made up of two items, namely, a carrying and a terminal charge and, though the canal could move freight cheaper than the rail lines it had no public terminals, whereas the railroads had these aids. This placed our early canal at a great disadvantage and was the chief cause for its decline.

The construction of the Barge Canal, with its terminals, waterhouses and multitude of freight-handling machinery has wiped out the disadvantages of the old route and has, in addition, provided a means for handling freight at a cost which is less than that asked by the railroads. The rail lines have not been able to cut down their terminal charges to the same extent that they have their carrying charges, due largely to the fact that they have been more interested in transporting freight than in reducing the total cost of handling it.

The last Legislature appropriated funds to start the construction of State-owned grain elevators at Oswego and on the

(*Continued on page 555*)

# The electric cable for big jobs

THE sturdy endurance of Duracord is fast making it a national standard for magnetic cranes, three phase drills, cement and sand mixers, portable loaders and other places where large size cable is used.

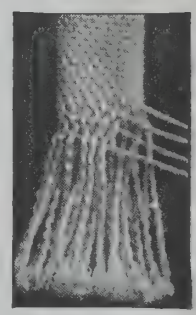
Duracord's thick *woven* fabric covering stands up to the hardest kind of service. *The costly renewals of large cables are greatly reduced.* Men and machinery are kept working.

Specify Duracord and banish cord-worries for good. Duracord is made in the larger sizes of single and duplex cable and in all sizes of portable electric cord for drills, extension lamps, etc.

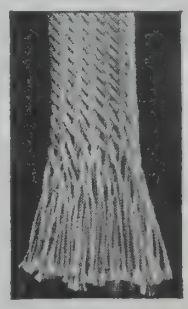
Ask your electrical jobber about Duracord or let us send you samples of Duracord and ordinary cord for you to test and compare yourself.

**TUBULAR WOVEN FABRIC CO.**
**Pawtucket, R. I.**

*Makers of Duraduct*
*Flexible Non-Metallic Conduit*
*and tubular woven fabrics of all kinds.*

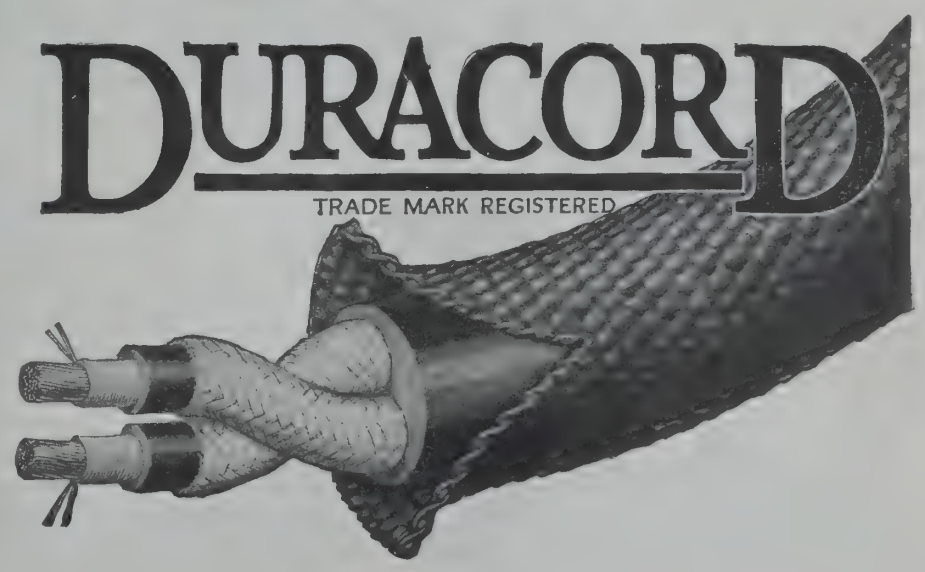


*This is Duracord. Thick, heavy strands, woven like a piece of fire hose, not braided. Picture shows outside covering only with impregnating compound removed.*



*Here is the ordinary braided cable covering. Note the open and porous construction, easily cut, stretched or unraveled. Compare it with the illustration of Duracord above.*

DURACORD
TRADE MARK REGISTERED



# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farm Implements, Etc.*

## Pertaining to Apparel

GARMENT PROTECTOR.—K. HEITLER, 605 W. 141st St., New York, N. Y. The invention relates to the construction of a sanitary garment which encircles the limbs and abdomen of the wearer; the device is equally applicable to infants or grown persons of the female sex; it will permit a sufficient quantity of air to come in contact with the parts enveloped and permit the evaporation of perspiration although preventing the escape of any fluids.

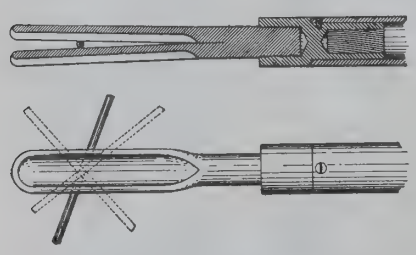
## Pertaining to Aviation

AIRPLANE.—P. T. WOLFE and W. H. BOVARD, 1241 West 38th Place, Los Angeles, Cal. An object of this invention is to provide an arrangement of rotary planes which serve to support the device in the air and to quickly elevate the same in a substantially vertical line or permit the descent thereof. A further object is to provide an airplane which can be operated to start and light without the necessity of running over the ground.

## Electrical Devices

ELECTRIC SWITCH.—H. F. IRRGANG, Box 72 St. Marlies, Idaho. The primary object of the invention is to provide a mounting for switch handles, which embody a movable bridge piece, which will completely safeguard the person manipulating the same against contacting with any of the charged parts of the switch in moving the bridge piece to break or make the circuit.

ELECTRODE HOLDER.—W. E. CLEMENTS, Oroville, Cal. The invention relates more particularly to electrode holders designed for electric welding, an object being to provide a construction of fork consisting of two spring



AN ELEVATION AND LONGITUDINAL SECTION OF THE DEVICE

members adapted to grip an electrode between them, these members being so shaped transversely as to give a three-point contact engagement with the electrode, thereby securely holding it but permitting of any desired angle in accordance with the operation to be performed.

WIND WHEEL ELECTRIC GENERATOR.—A. H. HEYROTH, Geraldine, Mont. The object of this invention is to simplify the construction and operation of generators of the character referred to so as to be more reliable and efficient in use, economical to manufacture, and so designed as to be used in combination with a rectifier, whereby continuous current can be obtained for the charging of storage batteries and other purposes.

## Of Interest to Farmers

FARM IMPLEMENT.—D. D. SOMMERS, Box 161, Champion Alberta, Canada. The principal object of this invention is to provide a bar which trails along beneath the surface of the ground for destroying weeds and heavy grass, either by pulling the weeds or grass up by the roots and leaving them on the top to dry, or by bending them flat with the top of the ground and covering them with earth to such a depth that they will decay.

SCARIFIER ATTACHMENT FOR ROAD GRADERS.—J. A. WILLIAMS, Box 152, Aurora, Mo. A purpose of the invention is the provision of a scarifier of simple and efficient construction having teeth of a form to permit additional metal being welded thereon when they become worn or broken, thereby eliminating any waste of the metal. The device is provided with means for attaching it to any standard form of road grader.

STEERING MEANS FOR TRACTORS AND OTHER VEHICLES.—R. TINKER, Box 292, Monmouth, Ill. This invention has particular reference to the steering of tractors where two frames are pivoted together on a vertical axes, the adjacent corners of the coupled frames being drawn together on either side as desired, which causes a lateral movement of the coupled frames one relative to the other for steering purposes.

## Of General Interest

SAMPLE CARD.—A. WEINBACH, 696 Howard Ave., Brooklyn, N. Y. The object of the invention is to provide sample cards for displaying samples of woven fabric and more particularly relates to cards on which the samples are carried by tabs detachably secured to the card, whereby a card formed of a single sheet of material is adapted to receive samples on both sides, the securing tongues being protected and concealed.

COLLAR BAR.—A. BROWN, c/o M. J. Graner Co., 334 5th Ave., New York, N. Y. The invention relates to collar bars for use at the front of a soft collar for retaining the adjacent ends in position, and more particularly relates to collar bars of the type presenting clamps at the ends between the members of which the opposed lateral edge portions of the collar are adapted to receive the clamp for making a neat fastening.

FISHLINE ATTACHMENT.—M. J. CROSBIE, 152 West St., New York, N. Y. The patentee provides a useful device easily applied to a fishline at any desired point for attacking the snell. The form of the device maintains the baited hook away from the line to afford an attractive lure and prevent tangling of the snell with or without the fish. The device can be conveniently applied and should prove especially useful for deep-sea fishing.

SECTIONAL SCAFFOLD.—J. J. MACKLEM, Goshen, Ind. This invention has reference more particularly to a sectional structure with bracing and locking adjuncts whereby the whole may be readily assembled and disassembled. The primary object is to provide a ladder scaffold which will be simple in construction, strong and efficient in use, and readily adapted to various conditions and locations.

COLOR INDICATING CHART.—J. F. KAUFMAN, 883 7th Ave., New York, N. Y. Among the principal objects of the invention are to quickly ascertain the colors which harmonize by contrast or by combination to vary the harmonizing colors correspondingly, to register the colors employed for identification, to shade and tint, key and coördinate colors correspondingly, and to mechanically ascertain from a given key any of the color harmonies desired.

ALLOY.—F. MILLIKEN, 55 John St., New York, N. Y. The object of the invention is to provide an alloy more especially designed for use in mine water valves and other devices subjected to weak acids. The alloy consists of the following metals in approximately the proportions specified: Copper 42-52 per cent, nickel 22-28 per cent, lead 22-30 per cent.

GYROSCOPIC TOP.—K. EDISON, c/o Harry E. Block, Spring Valley, N. Y. Among the aims of the invention is to construct a gyroscopic top which may be operated entirely independent of any cord in that it combines as an essential part of its mechanism an operating means for a gyroscopic wheel, and further, the invention combines a structure which will cause a continuance of the stabilizing feature even after a cessation of the rotation on the part of the wheel.

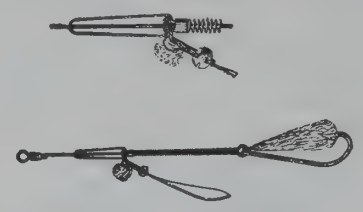
PASS BOOK.—T. P. MARTIN, JR., c/o Oklahoma Stock Yards National Bank, Oklahoma, Okla. This invention relates more particularly to a pass book construction which embodies a detachable inner pad in order to allow of renewal from time to time, the prime object being the provision of a cover permitting of ready use of the ordinary pass book pad in such manner as to show the depositor's name through a window in the cover.

BOTTLE CLOSURE.—C. E. BLANCHARD, 3811 Cottage Grove Ave., Chicago, Ill. An object of the invention is to provide an inexpensive bottle closure which may be secured to a bottle container liquid and which will substantially prevent the refilling of the bottle without detection. A further object is to provide a closure which hermetically seals the bottle, it being only necessary to cut off a portion of the closure to permit the pouring out of the contents of the bottle.

REVERSIBLE CHAIR.—F. S. PASCOE, Cristobal, Canal Zone, Panama. The invention relates particularly to a chair designed for use by a small child, an object being to provide a device which is reversible, so that when it is in one position it functions as a small rocking chair and when in the inverted position functions as an auxiliary seat for an ordinary dining chair to provide in effect, a high chair.

UMBRELLA.—R. ESTURO, 213 E. 80th St., New York, N. Y. This invention pertains more particularly to the handle structure of an umbrella. The primary object of the invention is to provide an umbrella in which the top is capable of rotary movement relative to the handle. A further object is to provide an umbrella in which the handle may be removed.

TROLLING SPOON.—J. T. MOORE, 407 East St., Eureka, Cal. The aim of the invention is to provide a trolling spoon device wherein the user may provide himself with one basic part and supplement such basic part



A PERSPECTIVE VIEW OF THE DEVICE

with different spoons, decoys and hooks, which are detachably secured to said part, thus saving a sportsman expense in outfitting himself for the catching of various fish. The substituting of one form of hook for another may be effected just as readily as the disengagement of the spoon.

RECEPTACLE CLOSURE.—D. BLOOM, 1526 McGee Ave., Berkeley, Cal. The aim of this invention is to provide a receptacle closure which will produce an absolutely air-tight closure. A further object is to so construct the device that it may be readily sealed by any one without the practice of any degree of skill, and although sealed in such a manner as to be air-tight, may be opened instantly. The closure may, after the opening of the receptacle, be used as a lid.

TABLE IMPLEMENT. — E. DE TEIXEIRA, Setauket, L. I., N. Y. Among the principal objects which the invention has in view are to provide a single implement for numerous uses, to meet the several demands for the preparation of food for personal consumption, to economize the transportation space, and to avoid loss of implements. The implement includes a table fork with cutting edge, spoon, corkscrew, nut cracker, can opener, cutting blade and a wedge-shaped end for cutting ice or similar service.

MILK CAN HANDLE.—P LAMBRAKOS, 206 E. 59th St., New York, N. Y. The invention relates to handle attachments, and more particularly to a handle device for clamping upon cylindrical bodies such as milk cans and the like to facilitate the handling and transportation of the milk cans. It is an object to provide a handle attachment having a rotatable element rigidly mounted on a frame, the whole of which may be quickly and conveniently attached to the can.

WINDOW SEAT.—L. VIEZZI, 435 W. 7th St., West New York, N. J. The object of the invention is to provide a seat for the accommodation of a person employed in washing, or doing other work outside a window; the device is arranged to permit of being conveniently and quickly attached to the window sill, and projecting sufficiently far out to enable the occupant to readily wash the window or do other work without danger of losing their balance and falling.

HAIR WAVER.—H. NATKIEL and I. FREEDMAN, 218 E. 122nd St., New York, N. Y. The invention relates to ladies' toilet articles. Among the objects is to provide a simple and easily manipulated device for curling or waiving hair. The device comprises two outer reversely bent bow-shaped bars rigidly connected at one end, and a third bar located between the first two mentioned, the third bar having a sinuous form upon which the hair is adapted to be wound, the ends of the bars being provided with a locking hook.

SPOOL.—B. N. KNOCHE, 219 Grand Ave., Baldwin, L. I., N. Y. The object of this invention is to provide an exceedingly light thread carrying spool. Another object is to provide a spool made from a single piece of material such as wood, wood pulp and the like, which is strong, and arranged to properly fit the spindle of the machine on which the spool is to be used.

TELESCOPE.—M. LICHTMAN, 172 E. 93rd St., New York, N. Y. This invention relates to telescopes, and more particularly to means for securing an eye piece and object glass to the telescope, and also a catch which is adapted to secure the barrels of the telescope in a plurality of positions. An object is to provide a telescope which is simple in construction so that it may be manufactured at a low cost.

## Hardware and Tools

PIPE WRENCH.—A. W. KIEFER, 1909 N. Keystone Ave., Chicago, Ill. Among the objects of the invention is to provide a pipe wrench which can be quickly adjusted under working conditions to firmly hold objects of varying size, to provide a device in which the gripping members will hold more firmly when a positive turning force is applied, and in which any worn or broken parts may be replaced at small cost.

SCRIBER.—L. VIEZZI, 435 W. 7th St., West New York, N. J. This invention has for its object to provide a scriber for use on squares and similar drafting tools such as are generally used by carpenters and other persons and arranged to enable the user to accurately set the scribe for conveniently drawing a desired line over the surface of the work. Another object is to permit the use of a pencil or a steel pin as the scribing tool.

WORK HOLDING CLAMP.—H. I. LAVERS, 30 Irving St., West Somerville, Mass. This invention relates generally to work holding clamps, and particularly to a clamp for holding portions of carpenter or cabinet work together until the glue used for uniting the same has become sufficiently set. It is the purpose of the invention to provide a clamping and forcing device in a single element so that the two functions are performed simultaneously.

GROOVE CUTTING TOOL.—J. A. LEWIS, 603 Kickapoo St., Hartford City, Ind. The object of this invention is to provide a tool adapted for rotary engagement within a piston ring groove of a piston and carrying a cutting blade whereby upon rotation of the tool upon the piston an oil groove will be cut, the particular advantage of the device being that it eliminates the necessity of placing the piston in a lathe to effect the cutting.

NUT LOCK.—J. A. YOUNG, Belair, Md. The invention relates to an arrangement for positively locking the nut on the bolt against turning, yet permitting minute adjustment and convenient application or removal of the nut. A further object is to provide a nut lock of that type in which the bolt is provided with

AN ELEVATION OF A BOLT AND NUT ENGAGED WITH LOCKING MEANS

a longitudinal groove, and the nut is equipped with an annular recess or chamber circumscribing the thread opening and adapted to accommodate a locking means in the form of a split ring adapted to simultaneously engage the bolt and nut to prevent the latter from turning on the former.

## Heating and Lighting

HUMIDIFYING RADIATOR UNIT.—F. E. GROSVOLD, address A. H. Shoemaker, Eau Claire Natl. Bank Bldg., Eau Claire, Wis. This invention refers more particularly to a radiating unit which has a receptacle for water bordering the edges of the heating space through which the heating medium is circulated. An object is to provide a unit having a humidifier associated therewith, which may be attached at any desired point of a complete radiator. The unit is suitable for any method of heating in which radiators are employed.

WATER SEAL VACUUM VALVE.—J. H.

(*Continued on page 556*)

## Making the Barge Canal Pay

(*Continued from page 553*)

Gowanus Bay Terminal in Brooklyn. The Oswego elevator will have a capacity of one million bushels of grain, while the Gowanus Bay structure will hold two million bushels. These elevators have been planned and their construction will be well under way in the near future.

The State of New York has done everything it could to make its waterway a success. The officials having to do with canal matters have exerted every effort to push the project to completion, and it is now strictly up to the people to cooperate and by coöperation obtain all the benefits to be derived from the full utilization of the canal system that has been provided. There are four definite lines of work which can be followed to make New York's waterway a great carrier. These are: First, to urge upon members of the Legislature favorable action on appropriations for the further development of canal terminals; second, to assist in the organization of competent operating companies and the construction of barges; third, to divert freight to the Barge Canal and urge similar action upon others; fourth, to seek coöperation between shippers and carriers and the coördination of fresh and salt water transportation facilities.

## Tuning and Testing

(*Continued from page 545*)

passes this test, it is running so smoothly that a new dollar or a pencil can be balanced on top of the engine and will stand without falling.

The defects which are found inside the engines are usually of the kind that can be detected only with the stethoscope. One such is what is known as "piston slap." This is a noise so small that no automobile engineer discovered it until other noises were eliminated by the construction of the smooth and silent engines that are being turned out today. It is notable that the discovery of this noise was made in American and not in European engines. The reason is that in many makes of motors, including several of the famous European cars, the pistons can slap persistently and no one can discover it because of other noises.

Of course, engines which fail to pass this test and are sent back for tuning up, must come again to the dynamometer rooms and eventually pass 100 per cent in every way.

Thus, in the finished product, the results of American quantity plus quality work come to a focus. The selection of metals, the scientific heat treatment which surpasses anything that can be accomplished by the judgment of the most skilled worker, the accurate machine work and the inspection which insures uniformity of product, have all contributed to an unequaled result. An engine is turned out that is without a peer and yet is turned out in large quantities and of so uniform and perfectly standardized construction that in case any one of its hundreds of parts needs replacement, the first piece that comes from the stock bin will fit and function perfectly.

A single example of the ultimate test of the results obtained, completes proof of American superiority. There is a single company operating a bus line in California which is now running 52 cars of a high grade American make and keeps in reserve only three cars to replace possible break-downs and to permit repairs, service, and overhauling. Each of these cars makes an average run of 340 miles a day. Some of them have been in service for years and at least eight of them have run up a total mileage of about 300,000 miles while one has passed 350,000 miles.

European production has offered nothing which can in any way compare with this record of American achievement either in quality or quantity manufacture.

## The Dawn of American Commercial Aviation

(*Continued from page 546*)

As to the useful load, this is represented by the following items:

| | Pounds |
|---|---|
| Passengers (11) | 1,980 |
| Mail | 500 |
| Crew (2) | 360 |
| Gasoline (230 U. S. gallons) | 1,437 |
| Oil (20 U. S. gallons) | 150 |
| Total useful load | 4,427 |

The total weight in flying order is therefore 12,883 pounds, or nearly six and a half tons.

This great weight is carried by biplane wings of an aggregate supporting area of 1,397 square feet. The upper wings have a spread of 103 feet 9 inches, while the lower wings are 74 feet 4 inches in span. The wing chord measures 8 feet and the interplane gap, that is, the perpendicular distance between the upper and the lower wings, 8 feet 10 inches. The overall length of the machine, from the stem to the trailing edge of the rudder, is 49 feet 3 inches, and the overall height 18 feet 9 inches.

The propelling apparatus consists of two naval type Liberty XII engines, which have a total consumption of 64.2 gallons of gasoline and 3 gallons of oil per hour for an output of 700 horsepower. The engines are mounted with their direct drive propeller between the wings on either side of the center line. An electric starter fitted in the cockpit enables the pilot to get under way without outside assistance. The full speed these flying boats develop is 85 miles per hour, while the landing speed is 50 miles per hour.

Perhaps the most striking feature of these air liners is their extremely sturdy construction. The generous size of wing spars and interplane struts as well as the obvious strength of the double-planked hull, built of Port Orford cedar, are likely to prove a revelation to the layman who still pictures aircraft as flimsy contraptions of sticks and wires.

The first of these Aeromarine liners last summer safely carried hundreds of passengers from New York to Atlantic City, Newport, R. I., Southampton, L. I., and other places on the Atlantic coast. These performances and the splendid war record of these flying boats are the best proof that the Key West to Havana airway will be operated with craft which fully deserve the confidence of the traveling public.

That the establishment of an airway between Key West and Havana saves the traveler both time and inconvenience will be obvious from the following: Travelers who arrive at Key West at 2 P. M. have to wait eight hours for the boat to Havana and the sea voyage consumes the whole night, the boat reaching the Cuban capital only the following morning. The Aeromarine liners now leave Key West half an hour after the arrival of the train and cover the odd hundred miles' distance to Havana in an hour and a quarter. The traveler is thus spared the inconvenience of a tedious sojourn in Key West and the even less pleasing prospects of seasickness before seeing Morro Castle, while the actual saving in time represents virtually a whole day.

What such a shortening of the trip between New York and Havana means to the man who has to take the trip owing to urgent business reasons or personal affairs is obvious. The experience of the London to Paris airway shows that people in a hurry invariably take the airway in order to escape the delays attendant upon inadequate rail and boat connections. But it may be expected that besides the man-in-a-hurry there are other travelers who will take to the air. The desire

(*Continued on page 557*)


A Modern Model

THIS business-like building was erected by the Modern Foundry Co. for present use as a pattern shop and storage building.

The top floor, with its middle bay extra-lighted and ventilated by the sawtooth is splendidly suited, not only to accurate pattern-making but to any sort of fine machine work.

The other floors are almost as well equipped, for the upper and lower ventilators, connected by double arms, insure balanced in-and-out air movement whenever they are opened.

Such liberal glass and ventilating areas are not necessary for pattern storage: but in case a manufacturing building is later needed at this site, this building will be an asset, not a liability.

And the fact that so far-sighted a concern chose Lupton Factory Sash and Pond Continuous Sash for the walls and roof of this model building is not without significance. We will send you literature on the technical features of these sash on request.

—Yes, the Modern Foundry Co. is using the Pond Truss design for their new foundry buildings, with highly gratifying results in both light and ventilation.

"Today — the Sash makes the Factory"

*Modern Foundry Co., Cincinnati, O. Pattern Shop and Storage Bldg. Zettel & Rapp, Archts. Lupton Pivoted Factory Sash used in walls; Pond Continuous Sash in roof.*

DAVID LUPTON'S SONS COMPANY
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Lupton Pivoted Factory Sash—*Cat. 10-LSS*
Lupton Counterbalanced Sash — *Cat. 10-LCB*
Lupton Steel Partitions and Doors—*Cat. 10-LSP*
Lupton Rolled Steel Skylight — *Cat. 10-Misc.*
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## RECENTLY PATENTED INVENTIONS

(*Continued from page 554*)

LINDSAY, 1117 Jefferson Ave., Brooklyn, N. Y. An object of this invention is to prevent the escape of steam and to render the thermostatic element quickly responsive to the level of water and to the contact of steam therewith so as to cause the valve to operate and maintain at all times a water seal at the valve outlet to prevent the escape of steam.

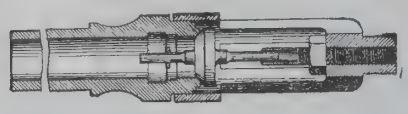
APPARATUS FOR RETURNING WATER TO BOILERS.—D. N. CROSTHWAIT, JR., Marshalltown, Iowa. The invention relates to means by which water may be fed or returned to a boiler from a level lower than the water line of the boiler. An object is to provide water return pumps or traps operated automatically by steam pressure applied to the body of water in the trap, and particularly by aid of an ejector located in the receiver and to which steam is directly admitted.

HOT AIR HEATER.—J. W. FIEBER, Shaw, Ore. The particular object of the invention is to provide devices for heating air for use in fruit evaporators, the heater is capable of utilizing a variety of heating means as well as one which will produce a very dry heated air and may be easily and quickly attended to. A further object is the provision of a heater by means of which the fruit may be dried with a proportionately reduced loss in weight and better color.

### Machines and Mechanical Devices

EMULSIFYING MACHINE.—J. F. SCHLAPPI, 1917 Grand View Blvd., Sioux City, Iowa. The invention has for its object to provide an emulsifying machine by means of which an emulsion between two or more substances not capable of chemical combination may be intimately mixed to form the emulsion. The emulsifier is simple in construction, easy to operate and inexpensive to manufacture.

VALVE STRUCTURE FOR OIL WELLS.—J. P. MCEVOY, Box 206, Sour Lake, Texas. An important object of the invention is to provide a structure with a view to increasing the efficiency and durability of the device. The



A CENTRAL VERTICAL LONGITUDINAL VIEW

valve structure herewith shown is of the reciprocatory type, and is employed in the well casing of an oil well. It may also be embodied in a standing valve structure, wherein the barrel or body portion of the device is stationary.

FLYWHEEL BALANCER.—M. MACHROL, 570 Prairie Ave., Kenosha, Wis. An object of the invention is to provide a device by means of which the surplus metal on one side of a flywheel may be readily located and removed. A further object is to provide a device having a scale which will indicate the amount of metal to be removed, and to provide a fly balancing device which consists of few parts, therefore easily constructed and not liable to get out of order. The device may be adjusted to flywheels of different sizes.

OIL RETAINER.—H. C. UTTECH and A. E. OHRMUNDT, Lebanon, Wis. This invention has for its object to provide a construction and arrangement of oil retainer in connection with a gear case or machine element of any character, which permits a free lubrication and yet which maintains a leak proof gasket around the shaft. The device dispenses with the necessity for the ordinary stuffing box and consequent frictional engagement with the shaft.

MACHINE FOR HANDLING ENSILAGE.—G. A. LONG, Mooresville, Ind. This invention relates to machines for handling ensilage and has for its object to provide a device especially adapted for use in silos for tamping the ensilage as it is placed in the silo, wherein the machine is operated by the feeding of the ensilage from the cutter; the ensilage is fed to the silo through a sectional pipe, the lower sections being removed as the silo fills.

SHANK BUTTON MACHINE.—B. VESELY and W. FAJMAN, address Bedrich Vesely, 1145 4th Ave., Astoria, L. I., N. Y. The invention has particular reference to means for forming shanks and drilling the eyes through the shanks of shank buttons such as are commonly made from clam shells, or other natural material or its equivalent. Among the objects is to provide a machine of a relatively simple, compact and reliable nature adapted for rapid manipulation.

FLEXIBLE COUPLING.—G. E. TOMLINSON, Winchester, Ky. This invention relates to a flexible coupling which may be employed in conjunction with any type of power-driven shaft where the driven shaft extends at a fixed or varying angle to the driving shaft, which coupling will require no attention whatever, such as oiling, wherein the wear will be reduced to a minimum, and which will be capable of absorbing shocks to a certain extent.

ADJUSTABLE CHASE AND LOCKUP FOR PRINTING, CUTTING AND CREASING PRESSES.—E. KARL, 20 W. Main St., Litchfield, Conn. An object of the invention is to provide a device which will securely clamp the plate and which is capable of a wide range of adjustment. With this mechanism the operation can be quickly performed and the device will securely clamp the plate or type set up, While the parts are adjustable, they are rigidly fixed when once clamped in position.

DEVICE FOR ARCHING AND FITTING SEMI ELLIPTIC SPRINGS.—J. I. ROBERTS, Box 635, Prescott, Arizona. The invention relates to devices for forming and shaping semi-elliptic springs. An object is to provide a device adapted more particularly for use in the blacksmith's shop. The device comprises a trestle, a presser frame with handle to be borne on by the operator, a fixed presser roll with a handle for turning it, and a companion presser roll with a swinging mounting on the frame.

APPARATUS FOR HARD TWISTING OF FINE AND THICK THREADS.—H. P. MITTET, Avlesund, Norway. The object of this invention is to provide an apparatus for hard-twisting of thread, to be placed on an ordinary twisting machine with pliers or a similar machine, by means of which the thread is given a sufficient twist, and from which the thread is passed directly to the twisting machine in a continuous process.

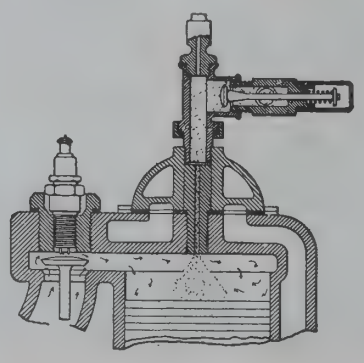
ROLLER CLEANER.—M. E. VAN BROCKLEN and R. HAIDEN, 4 Mohawk Place, Amsterdam, N. Y. This invention has for its object to provide a device adapted for use with spinning mules, for cleaning the rollers of the spinning jacks, wherein the arrangement is such that when the cleaner is placed upon the roller it will travel the full length of the roller, thoroughly cleaning the same, and requiring no supervision on the part of the spinner, and it may be used upon many machines.

### Musical Devices

MUSIC LEAF TURNER.—J. O. GEMSEY, Montevideo, Minn. The purpose of this invention is to provide a music leaf turner adapted to be applied to a music stand of the standard construction, which can be readily adjusted to fit the stand irrespective of its height, the turning mechanism being adapted to be actuated by the foot of the operator for successively turning the leaves as they are played.

### Prime Movers and Their Accessories

AUTOMATIC GRAPHITE LUBRICATING SYSTEM FOR INTERNAL COMBUSTION ENGINE CYLINDERS.—J. D. LOOG, 447 E. 173rd St., New York, N. Y. The invention relates to a system of lubrication in which finely divided flaked graphite is directly admitted into the cylinders without loss of compression. An



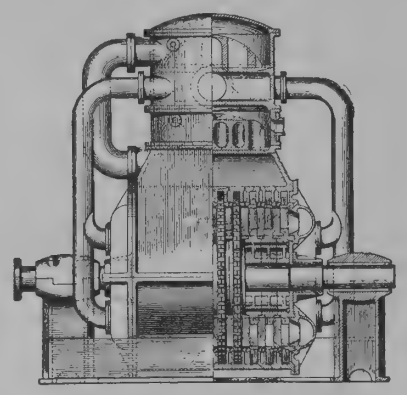
A SECTIONAL VIEW, SHOWING THE LUBRICATING SYSTEM

object is to operate the system automatically by the suction stroke of the engine in such manner that the graphite may freely pass directly into the cylinders, without the possibility of clogging the duct, and that the graphite on reaching the cylinders be distributed with the help of the inrushing gas vapor on the walls, where it forms a lubricating film.

POWER TRANSMISSION.—W. C. NUTT, Port Marion, Pa. An object of the invention is to provide mechanism for transmitting motion from a drive shaft to a crankshaft at right angles thereto. A further object is to provide a cam wheel and oscillating rame with rollers on the frame engaging the face of the cam wheel and compelling the movement of the frame due to the changing angular disposition of the cam wheel.

COMMUTATOR GRINDER.—F. E. FULLER, 1550 Williamette Blvd., Portland, Ore. This invention more particularly relates to a grinder or polisher for removing accumulations of dirt, and truing up the contacting surfaces of a commutator or timer for internal combustion engines. An object is to provide a simple grinder which is of such nature that it can be readily applied and easily removed.

MARINE STEAM TURBINE.—A. M. RODBERG, Box 1772, Tampa, Fla. This invention relates more particularly to a heavy duty reversible turbine for marine use, and among its various objects aims to utilize the expansive



A SIDE VIEW PARTLY IN SECTION

and impact force of steam to a maximum degree and at the same time provide for ready reversibility and similar speeds and power in both ahead and astern duty.

CARBURETING SCREEN.—F. W. LAPHAM, 5035 W. 33nd St., Cicero, Ill. The invention relates to a combined cylinder gasket and screen for use in connection with internal combustion engines. An object is to provide a screen arranged at or near the intake valve, and which is adapted to thoroughly atomize and vaporize the charge prior to its passage into the cylinder. A further object is to render the installation of the screen simple and easy.

COMBINED BY-PASS AND RELIEF VALVE.—E. B. WHELAN, 1025 S. 10th St., Omaha, Neb. This invention relates to that class of valves which are adapted to be used in steam engines of the piston-valve type, and individually to perform in such an engine, as occasion may require, the function of a by-pass valve and also the functions of a vacuum and compression relief valve.

### Railways and Their Accessories

RAIL JOINT.—D. MCEACHERN, Box 922, Nelson British Columbia, Canada. The invention relates to rail joints of that type wherein the ends of rails are not only connected, but are supported as well, so as to prevent excessive vibration of their contiguous extremities, the object is the provision of a simple means for maintaing the parts under an active tension at all times directed toward tightening the same and compensating for wear.

RAILWAY GATE CONTROL MECHANISM.—F. W. GRANT, 674 Marlborough St., Detroit, Mich. An object of the invention is to provide means without the use of a complicated construction, for the protection of street crossing railways by gates which are automatically closed by electrical energy on the approaching of a train from either direction, and automatically opened after the train has passed the crossing.

### Pertaining to Recreation

TOY MACHINE GUN.—H. ABRAMOWITZ, 176 Eldridge St., New York, N. Y. The general object of the invention is to simplify the construction and operation of toys of this character so as to be efficient in use, and inexpensive to manufacture, and so designed as not to readily get out of order. A more specific object is the provision of a machine gun which by operating a single crank, causes the projecting of a bullet and the explosion of a cap.

GAME BOARD.—EMMA N. LAMBERT, 511 Seminole St., Bethlehem, Pa. An object of the invention is to provide an arrangement of lines and spaces for use with game pieces for the playing of different games. A further object is to provide a game board which will be ornamental and attractive in appearance, and cheap to manufacture and entertaining in use.

### Pertaining to Vehicles

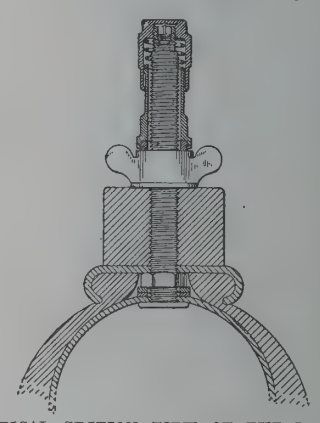
SPARK AND THROTTLE LEVER LOCK.—J. H. PRICE, 322 N. Ellis St., Cape Girardeau, Mo. The aim of this invention is to provide a locking device capable of ready adjustment to fit spark and throttle levers of slightly different spacing. A further object is the provision of an arrangement wherein means are incorporated to avoid danger of defeating the purposes of a lock by unwarranted opening of the quadrant and shifting movements of the spark and throttle levers beneath the lock plate.

PATCH HOLDER.—C. A. ERDLEY, Mifflinburg, Pa. The invention relates to a device for holding an inside blow-out patch within a tire while the tire is being placed upon a rim; the patch including flaps passing beneath the beads of the tire, clasps engageable with the flaps, and a member connecting the clasps, whereby they may be drawn snugly against the outer periphery of the tire to hold the flaps firmly and prevent shifting of the patch.

MOTORCYCLE SEAT.—M. E. WOOD, 255 1st St., South Amboy, N. J. One of the objects of the invention is to provide a tandem seat suspension which may be readily applied to a single seater motorcycle as an attachment. A still further object is to provide a seat embodying a self-contained construction in which a foot rest is provided, and employing an elliptical spring as the resilient means with means for adjusting the seat to accommodate the user.

WHEEL LOCK.—C. E. THOMPSON, 222 E. 89th St., New York, N. Y. Among the objects of the invention is to provide a wheel lock which is adapted to be secured around the tire and rim of a wheel to prevent turning movement. A further object is to provide a lock which dispenses with the necessity for a key and which cannot be operated except by a person having knowledge of the movements necessary to release the device.

DUST CAP FOR TIRE VALVE.—G. B. MULLEN, Bell Ave. and Broadway, Bay Side, L. I., N. Y. Among the objects of the invention is to provide in combination a closure for the valve stem and a dust cap in which is provided means to compensate for the varying thickness of fellies. A further object is to



A VERTICAL SECTION VIEW OF THE DEVICE AS APPLIED

provide a dust cap which reduces the time of labor required for the inflation of the tire to a minimum by obviating the necessity of separately removing the dust cap and the valve stem cap.

BLOW OUT PATCH.—W. VAN V. HAYES, 772 Park Ave., New York, N. Y. The invention relates generally to means for repairing pneumatic tires in such a way that the device may be used either as a blow out patch or inner lining or the like. The primary object is to employ a conventional type of patch in so far as concerns its body portion, but instead of using the ordinary flaps or aprons to so construct the flaps that the patch will not slip, creep or otherwise move from its strengthening relation relative to the tire.

### Designs

DESIGN FOR A JEWELRY HOLDER.—P. VIGGIANO, address Hugh M. Martin, Shinnston, W. Va.

DESIGN FOR A POURING SPOUT FOR CANS.—H. L. STRONGSON, 147 West Broadway, New York, N. Y.

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## The Dawn of American Commercial Aviation

(*Continued from page 555*)

to escape seasickness will probably be one of the causes, while the enchantment the aerial traveler experiences aloft will offer a further inducement to go *via* the air route. And European experience shows that the keenness of this latter class of travelers for air transport increases with each trip.

## In the Modern Saw-Mill

(*Continued from page 548*)

automatic unstackers facilitate handling.

Handling the refuse of a large lumber mill presents a considerable problem. It consists largely of dust, edgings, and trimmings and a large proportion of it is used for fuel. Shavings and dust are lifted by suction and blown directly to the fuel bins. Slabs from the slasher and stub ends from the trimmer are suitable for making broom handles, lath, and the like and after all usable material has been picked out, the waste goes to the "hog" which cuts the refuse up in small pieces for fuel.

Shingle machines are operated in connection with the mill. The lumber is cut into bolts for them and their action is entirely automatic. The din from a battery of these machines is deafening.

Not only does the waste from a lumber mill furnish sufficient fuel to operate all the machinery, but there are instances where the lumber company sells electric power to the local light and power concern, which in turn sells it to other consumers.

The transfer of lumber in and around the mill was for many years mainly done by means of hand trucks. Two electrical devices have replaced this antiquated system—the storage battery truck and the telpher or monorail. The latter consists of an overhead rail from which is suspended a car or cars, equipped with electric hoists, the operator riding in the car. The telpher is, of course, restricted in its movements and electric trucks are used for the miscellaneous hauling that has to be done.

Even in a plant where the fuel costs nothing it is important to have an economical steam installation, because the greater the steam demand the greater the investment in the boiler room and its maintenance. For this reason steam turbines have replaced reciprocating engines in many mills. In others, where the power requirements have outgrown the capacity of the plant, steam turbines have been installed which receive their steam supply from the exhaust of the old reciprocating engine. Such installations have been made to deliver one horsepower for every horse-power delivered by the original plant. In other words the capacity of the plant is doubled with no additional operating expense.

In some cases where the use of steam in a few operations is insisted on a mixed pressure turbine has been installed. This turbine consists of two elements, one of which operates on high pressure steam and the other on the low pressure exhaust steam from the auxiliary engines.

Certainly our big lumber mills cannot be accused of wasteful methods. They are manufacturing plants of the most efficient type, in which both material and human effort are conserved to a fine degree.

## Carbonic Acid Gas to Fertilize the Air

(*Continued from page 549*)

toward the plants, thus allowing extensive areas to be supplied with the fertilizing gas. On the opposite side of the greenhouse plant there was provided for checking purposes a plot of the same size submitted to no carbonic acid gas, the soil in the two plots being of the same quality. Samples were derived from the best portions of the checking field, but from the center of the field submitted to the action of carbonic acid gas, the increase in yield in the case of spinach being found to be 150 per cent, with potatoes 180 per cent, with lupines (a legume) 174 per cent, and with barley 100 per cent. The potatoes in the field submitted to the action of carbonic acid gas were found to ripen much more quickly than in the checking plot.

The testing plant in view of these surprisingly favorable results was eventually extended, three greenhouses of the same size as those existing being added, while the small open-ground plant was increased considerably and more extensive grounds—30,000 square meters—were provided with an underground central pipe and branch pipes encircling lengthy plots. Especially favorable results were obtained on this field with potatoes, a 300 per cent increase being recorded in connection with tests on a large scale.

All experiments so far made go to show that fertilizing the air by means of carbonic acid gas is a much more efficient process than even an increased fertilization of the ground with stable manure and cow dung. If, on the other hand, a plot fertilized from the air at the same time be submitted to soil fertilization, the latter, on account of the increased need for other elements (nitrogen, phosphorus, potassium, etc.) entailed by the increased absorption of carbonic acid, can be driven much farther than otherwise.

According to Dr. Riedel's calculations an iron works dealing in its blast-furnaces with about 4,000 tons of coke per day will daily produce as much as 35 million cubic meters of combustion gases, containing 20 per cent carbonic acid gas. This is such an enormous amount that even in the case of a partial utilization most extensive plots of ground can be supplied with the precious air fertilizer. Dr. Riedel therefore believes that carbonic acid works for supplying agriculture will before long be quite as common a feature as electricity and gas works, the large industrial centers at the same time becoming centers of increasing agricultural production.

Careful analysis has shown the increase in the percentage of carbonic acid in the air to remain far below the limit where the gas becomes liable to endanger the health of man.

## Mechanical Stevedore That Handles Bananas

(*Continued from page 549*)

suspended rigidly from above at intervals; monorail trolleys of 250 pounds capacity, having roller bearings to carry the bunch of bananas suspended from a special hook to which the bunch is hung by a loop device invented by Mr. Steckler for the purpose; and a power-driven chain provided with fingers at three-foot centers, in constant motion at the rate of 125 feet a minute, the path of motion being parallel to the monorail at such location that the fingers engage the suspended bunch of bananas, and thus push the trolley along on the monorail.

The accompanying photograph illustrates the device. One track (Loop L-1) is parallel with the ship. It connects with several switches, each swiftly operated by compressed air. Down one switch the bananas that are turning ripe are first shunted to the waiting cars or wagons. The green ones are diverted down another switch, following the entire line of box cars on the siding. From this main line switch, a dead-rail line branches out in front of each car. The dead rail is down grade to the car door, and the bunches of bananas are delivered there without human handling. There are bumpers to prevent the bruising of the fruit. After the trolley is unloaded, it is sent back to its point of origin by a separate return system, and is there reloaded for further use.

It will thus be seen that there are only a few trolley switchmen between shipside and the cars, where formerly at least 400 men were working. These switchmen

# Wire Rope at Panama

The value of wire rope in constructing the great ditch to connect east and west at Panama can hardly be overestimated. Not only were the powerful "muscles" of the giant shovels and material handling cranes wire rope, but a big factor in the disposition of immense quantities of soil and rock was also wire rope.

To unload the "spoils trains", steel plows were hauled from end to end by steel cable, pushing the waste material off one side. So great was the friction on the cable that smoke was usually seen at intervals along the top of the train where the steel cable was cutting its way into immense boulders picked up by the powerful shovels.

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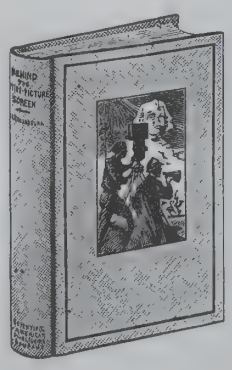

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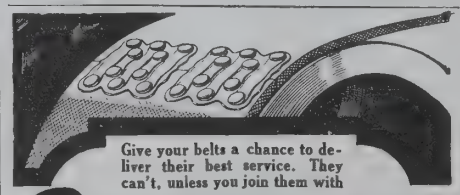

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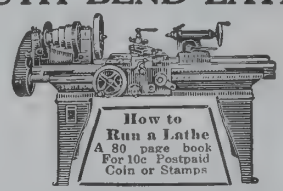


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are also inspectors, who would have been employed anyway under the old system.

Under the old system, to unload a cargo of 35,000 bunches required seven to eight hours and the services of 400 laborers for distribution to cars, giving at least 2,800 man-hours at 50 cents, a total of $1,400, or about 4 cents a bunch. Under the new system the same cargo is unloaded in five hours or less; no laborers are required for distribution. The cost includes a special loop device (which cannot be salvaged) for each bunch, 35,000 at 1½ cents, $525; one chief and three assistant operator mechanics at a total cost of $27; power consumption for distributor system at $16; and upkeep, including oil, depreciation, $12; a grand total of $580, with a difference in favor of the new system of $820, or more than 2¼ cents a bunch.

By extending the system into the ship itself, there will be a still great saving in time and money. Mr. Steckler is working on a plan whereby the under side of each deck of the fruit ships will be equipped with monorails radiating to the hatch opening; from here the trolleys, loaded with bunches of bananas, will be lifted by a marine tower, similar to the present device, and so transferred direct, without further handling, to the wharf monorail system.

## The Sectional Unit Factory

(*Continued from page 550*)

by the simple expedient of adding more sections. Roof sections conforming to all the demands of the situation are to be had; and when the width is carried far enough to require one or more longitudinal rows of supporting columns, these are to be had, together with roof sections appropriately modified to meet the case. Our illustrations give an excellent idea of the manner in which these structures are put together, both with regard to the framework and the outer skin of steel and glass, and also leave the proper impression of extreme flexibility. On this point little more need be said than that lengths vary by multiples of two feet, the width of the wall sections; while widths vary by multiples of from four to ten feet, according to the style. It will be noted, particularly, that the standardized sectional factory is not limited to an absolute rectangle, but may have ells and wings as desired, as well as vertical skylights and other modifications of the roof outline. These buildings are in successful use in many industries, and appear to have a bright future. A more conclusive answer to the problems of the business that cannot afford to build, today, against the requirements of ten years hence, and can no better afford continually to be scrapping old buildings in favor of new ones, would hardly be imagined.

## A New Idea in Factory Heating

(*Continued from page 550*)

maintenance cost is equally low. It is portable, requires no special foundation, and can be moved and relocated by common labor, ready for operation within a few hours. The principle is simple: Cool air at the floor level (or from outside) is drawn into the unit by a powerful fan-wheel), heated in its upward passage around steam-heated coils or a heated firing chamber, and then discharged at low velocity through directing outlet hoods into the open area. The gentle current of air thus established does not create drafts or air-blasts that impair the health of the employees. Where steam is available, the heater simply takes the place of the usual radiator; where steam is not available, the direct-fired type is required. Even under the severest conditions this heater requires firing only every four or six hours, so that its operation does not call for much attention.

## Roller Bearings for Line Shafts

THE purpose of roller bearings is twofold: First, roller bearings reduce friction and thus reduce power losses; secondly, roller bearings by the same token resist wear. Hence it is with considerable interest that we hear of the success which has attended the use of special roller bearings for line shafts in various factories. Not only has a material saving in power been effected by the use of such bearings, but equipment of this kind has shown remarkable proof against wear and deterioration. For 29 years in some plants these bearings have been running easily and economically, saving power and lubricant.

## Gravity as An Aid to Production

A PRODUCTION system is no more efficient than its line of supply. Keeping high-priced skilled hands busy, expensive machines "fed," output steady and up to capacity, is the job confronting the production man in small shop and large factory alike.

The story of the gravity conveyor is an old one, all well and true; but there is a decided touch of the novel in the very latest gravity conveyor installations. The leading factories today are using gravity conveyors in carrying materials and products from operation to operation, floor to floor, from automatic lathes to assembly department and from there to the packing room and shipping platform. The human wheel-lug-and-carry system is obsolete. Its drudgery involves a class of labor that cannot be other than indifferent, unreliable, inefficient. And the wages remain exorbitant.

In comparison the gravity system means all the difference between the ox-drawn plow of antiquity and the tractor-drawn gangplow. The gravity system can be arranged so that the production methods are served in the proper sequence. Starting at one end of the establishment, the materials and assembled articles can be conveyed along until finally they reach the shipping platform. The gravity systems are now constructed with switching arrangements, so that at a moment's notice the path of the flow can be diverted to meet changed requirements. All in all, the gravity method is as efficient as it is simple, and as flexible as it is positive in operation.

## Results of the First Finnish Fair

THE first fair held in Finland was opened on June 27 and lasted 10 days. Its aim was to give a comprehensive picture of the industrial achievements of the country and of the progress and possible future development of its commerce and industries. There has been a better opportunity of organizing the industrial life of the country since Finland has been independent than there was before. Thus, for instance, it has been possible to establish chambers of commerce in the principal cities and in the centers of commercial activity. It was owing to their efforts that the first Finnish fair was organized and held.

All branches of Finnish trade and industry were represented. The foreign exhibit also was rather large and varied, although most of the foreign firms exhibited through their local representatives. The import restrictions, however, caused difficulties. Practically no bargains could be concluded and foreign exhibitors were disappointed.

As yet it is impossible to draw any conclusions in regard to the sales of Finnish products. Many factories are so busy that they cannot take orders except for future delivery. It was not expected that many foreign buyers would come here under existing conditions, and comparatively few came. The English, who are among Finland's best customers, did not take much interest in the fair, as they were already familiar with the products which they usually buy—timber and paper.

The fair has, however, brought many and has been of importance in that way. It has also shown the development of Finnish industry, and the general opinion is that it has been a success.

LEGAL NOTICES

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(14358) W. L. writes: I am enclosing you one of your notes and queries No. 14341 that I do not exactly understand. In this you give the weight of sea matter at the bottom of the deepest known depth as 77.12 and the compressibility as 20 per cent of 1/5 denser than at the surface and I have read in your notes and queries before where you gave the weight as about 67.5 and the compressibility as 1/20 or 5 per cent, and as they do not seem to agree I am writing you this letter. A. The compressibility of water varies considerably as the pressure and temperature increases. The pressure at the depth of six miles is about 1,000 atmospheres. The compressibility at that pressure is .0000358 per atmosphere, or .0358 at the bottom. This works out as about 1/20, or 5 per cent, as you state, about 67.5 lbs. per cubic foot at the bottom of the ocean. It was by an inadvertence that we used 20 per cent in place of 1/20 for which we express our regret. There is however some uncertainty in these figures and they should not be used as more than approximations. The figures as given in the Smithsonian Physical Tables for pressures up to 3,000 atmospheres at temperatures up to boiling may be taken as the best available, if one requires the most accurate result to be had.

## NEW BOOKS, ETC.

PHOTOGRAPHY AND ITS APPLICATIONS. By William Gamble, F.R.P.S. New York: Isaac Pitman and Sons. 12mo.; 132 pp.; illustrated.

A little different from the usual photographic handbook, this slim volume is rather a narrative of present-day photographical applications, prefaced by a brief historical sketch. Even though the reader may not be a practiser of the art, he will find this simple outline of operations attractive. It includes color processes, scientific and industrial uses, cinema work, and photography in warfare.

BUILDING SUBWAYS IN NEW YORK. By Fred Lavis. New York: Hill Publishing Company, 1915. 4to.; 73 pp.; illustrated.

This reprint of articles appearing in *Engineering News* during 1914 is a graphic account of an undertaking rivalling the Panama Canal in expenditure, with a total investment greater than many of our big railroads. The numerous problems presented and triumphantly solved make an absorbing story. A paper on the design of steel elevated railways, by Maurice E. Griest, rounds out an informative brochure.

ELECTRICITY. Its Production and Applications. By Reg. E. Neale, B.Sc. New York: Isaac Pitman and Sons. 12mo.; 136 pp.; illustrated.

Only a broad survey of the most salient features of the subject can be compressed into so small a compass, but as a review of the general nature of this force which has made ours the electrical age, of the methods by which it is produced and the many ways in which it is turned to account by man, this text performs a distinct service to the reader.

WHO'S WHO IN AMERICA. Vol. XI., 1920-1921. Edited by Albert Nelson Marquis. Chicago: A. N. Marquis and Company, 1920. 8vo.; 3,302 pp.

At one time, few men were deemed worthy of widespread interest until they had been dead for some years. Now we demand to know those who please us with a picture, a book, or an invention, or who occupy our administrative offices. The new issue of "Who's Who in America" has 23,443 biographies of such men; by turning to his own State or town in the geographical index, the reader will frequently be surprised to find some neighbor whose unostentatious work has won him national recognition. There is inspiration


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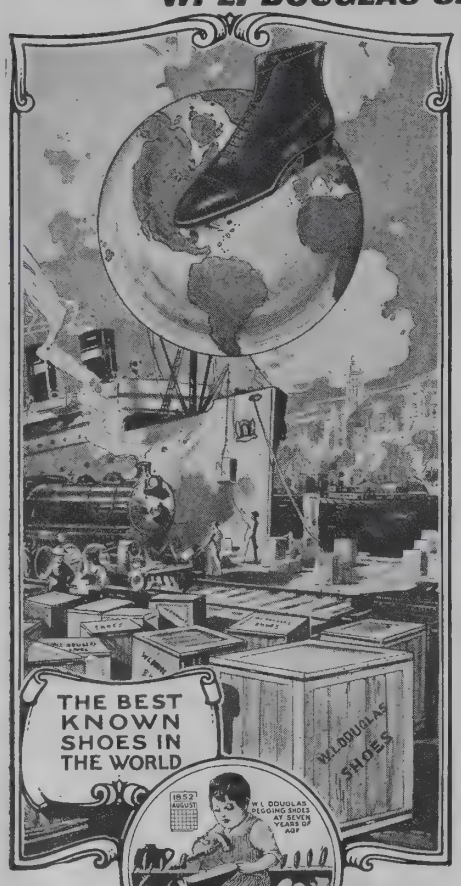

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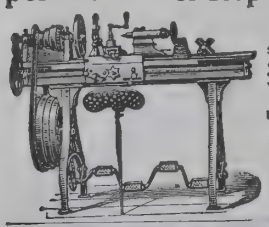

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as well as information in this biographical dictionary of the living, and we are pleased to note its increasing use by the schools. The pronunciation of the more difficult names is indicated, and the birth and residence statistics show an increasing percentage of names from the western States.

KNOWLEDGE ENHANCED. By Luther Stockton Fish. 1903 Woodland Avenue, Cleveland, Ohio: C. Hauser, 1920. 8vo.; 297 pp.; illustrated.

The main thesis of this book is an attempt to explain sleep by locating the sleep effectuating mechanism of the body. This, the author avers, comprises the eyes, the optic nerves, the peduncles and the mammillaries, these last forming the electrodes of the system and sleep being dependent upon the breaking of their contact.

THE AMERICANS IN THE GREAT WAR. Milltown, N. J.: Michelin Tire Company, 1920. 8vo.; Vol. I., 130 pp. Vol. II., 146 pp. Vol. III., 112 pp. Illustrated; colored maps and plans.

These volumes, part of a series of illustrated guides to the battlefields, cover the activities of our men in the second battle of the Marne (Vol. I.), the battle of Saint Mihiel (Vol. II.), and the Meuse-Argonne (Vol. III.) The sub-title, "a panoramic history and guide," is fitly descriptive of the excellent work. Offensives and plans of attack and defense are briefly sketched, with admirable plates of the dispositions and movements. Plain directions are given the tourist for finding the points of interest. Both stay-at-home and voyager will be quick to appreciate the unique merits of the guide.

HOW TO FLY AND INSTRUCT ON AN 'AVRO.' By F. Dudley Hobbs, B.A. New York: Longmans, Green and Company, 1919. 8vo.; 75 pp.; illustrated.

The author demonstrates his familiarity with the best methods of teaching aviation. While the manual uses the "Avro" in illustration of theory and practice, the exposition holds good, of course, for any airplane. Embodying British experience in the war, it provides material aid to instructional efficiency in civil aviation.

ETHICS AND NATURAL LAW. By George Lansing Raymond, L.H.D. New York: G. P. Putnam's Sons, 1920. 8vo.; 345 pp.

Desires of body and of mind are not necessarily developed from one another; often we become aware of a conflict between them, and that awareness functions as "conscience." Such is the thesis from which Professor Raymond extracts a fundamental principle that largely reconciles existing ethical theories. Although very closely and academically phrased, and inclined to the platitudinous in its later chapters, the work is a reconstructive review of ethical theories, makes distinctions that have vitality, and will repay the necessary study and application.

THE YACHTSMAN'S ANNUAL GUIDE AND NAUTICAL CALENDAR. Boston (134 Milk Street): Clarence B. Hogg, 1920. 8vo.; 404 pp.; illustrated.

Delayed by fire in the bindery, this hardy annual so familiar to yachtsmen and motorboat owners yet celebrates triumphantly its forty-second anniversary. Besides the usual encyclopedic information regarding tides, ports, rigs, and handling, a new coast pilot section covers all points from the St. Croix River to the Chesapeake. A nautical dictionary, signal codes, tables, and club directories are among the items, and the numerous folding charts are as prominent a feature as ever.

PLEADING FOR JUSTICE. By W. C. Burns. New York: Justice Publishing Company, 1920. 8vo.; 316 pp.; illustrated.

A "purpose" novel, interwoven by a love story, the purpose being to interest the reader in the equalization of freight rates and government ownership of the railroads, after a plan designed by the hero.

THE THEORY AND PRACTICE OF AEROPLANE DESIGN. By S. T. G. Andrews, B.Sc., and S. F. Benson, B.Sc. New York: E. P. Dutton and Company, 1920. 8vo.; 454 pp.; illustrated.

Like all the volumes of the "Directly-Useful Technical Series," this text-book supplies such a combination of theory and practice as will best serve the thorough-minded man. The first twelve chapters elucidate general principles and properties, stresses and strains, design as applied to particular parts, stability and performance, whereupon follows a chapter in which these considerations are applied to the lay-out of a complete airplane. The authors have had the coöperation of leading British manufacturers, publishers, and the Advisory Committee, and have utilized to the greatest advantage a striking collection of plates and diagrams that often serve the purpose of clearing up obscure points instantaneously, and always lend interest and definition to the text.

EXPERIMENTAL WIRELESS STATIONS. By Philip E. Edelman, E.E. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 392 pp.; illustrated.

This work, used extensively in war training camps, has been rewritten to include all recent improvements; the engravings are entirely new. The text assumes some knowledge of mathematics and electricity, presents the best practice in plain language, and develops basic principles in detail. There is much material on vacuum tube circuits, radio-telephony, and the mitigation of interference. The ambitious amateur will find here all the information necessary to qualify him for serious work in the commercial field.

MOTOR BOATS AND BOAT MOTORS. Compiled and edited by Victor W. Pagé, M.S.A.E. New York: The Norman W. Henley Publishing Company, 1920. 8vo.; 524 pp.; 372 illustrations.

Owners and operators of motor boats will doubtless find this such a manual as they have been waiting for. Part I, dealing with the construction and design of hull and fittings, gives classification and types with all details from stem to stern, and offers material aid in the selecting of a boat for any particular service; it concludes with five popular designs—working drawings and full building instructions—by A. Clark Leitch. Part II scrutinizes the power plant and its auxiliaries, with the features of leading types, ignition and starting systems, operation, care and repair. A final chapter describes seaplanes and flying boats, floats, power plants, installation, and control. The boating enthusiast will be pleased with the completeness and practicality of the material.

PRACTICAL PHYSICS. By Millikan and Gale. Revised in collaboration with W. R. Pyle, B.S. New York: Ginn and Company, 1920. 8vo.; 462 pp.; illustrated.

For many years the basic material of this text-book has proved its worth, and in its new form it continues to emphasize the daily environment of the pupil as a source of mental stimulation, devoting much space to the internal-combustion engine, the airplane, and the lessons of the war insofar as they touch upon physics. In arrangement and treatment the work is much improved. The full-page portraits of physicists, and the cuts illustrating recent achievements, add value to an elementary text of high merit.

THE LOCOMOTIVE. Vol. XXXII. Hartford, Ct.: The Hartford Steam Boiler Inspection and Insurance Company. 8vo.; 253 pp.; illustrated.

Bound into book form, these 1918-1919 numbers of *The Locomotive* present the usual array of accident news and statistics, fuel economy hints, and steam boiler instruction. Those looking for the newer points and practice in safety and economy will find the articles and drawings of definite aid toward these desirable goals.

DYKE'S AUTOMOBILE AND GASOLINE ENGINE ENCYCLOPEDIA. By A. L. Dyke, E.E. St. Louis: A. L. Dyke, 1920. 8vo.; 940 pp.; 532 illustrations.

The latest edition of this standard work adds supplements dealing with special makes of car, trucks and tractors, motorcycles, and airplanes. It combines in one volume a reference work and instruction book, presenting in the simplest manner the fundamental principles underlying construction, operation, cars and repair. Everything picturable is shown in plates, charts, cuts, and folding inserts, so that little is left to the imagination, and frequently information required may be had by a glance at a drawing, and much time thus saved. The work has taken a deservedly prominent place as a practical instructor.

NEW GEOGRAPHY. Book One. By Alexis Everett Frye. New York: Ginn and Company, 1920. 4to.; 272 pp.; 650 pictures and maps.

Space will not allow mention of all the new features of this text. Topics are frequently introduced by means of a story; pictures, colored and uncolored, set the romance of industry before the child; the states are grouped according to industrial and climatic divisions—the War Department plan; industrial information is kept well to the front, and joined with history and civics to illuminate and emphasize geographical facts; the maps present a new color scheme, and none of the essentials of primary geography are slighted.

IN THIS ISSUE:

ILLITERATE ADULTS
ITEMS IN BRIEF

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

TRANSFERRING COAL FROM SHIP'S HOLD TO THE COAL PILE

Vol. CXXIII. No. 23
December 4, 1920

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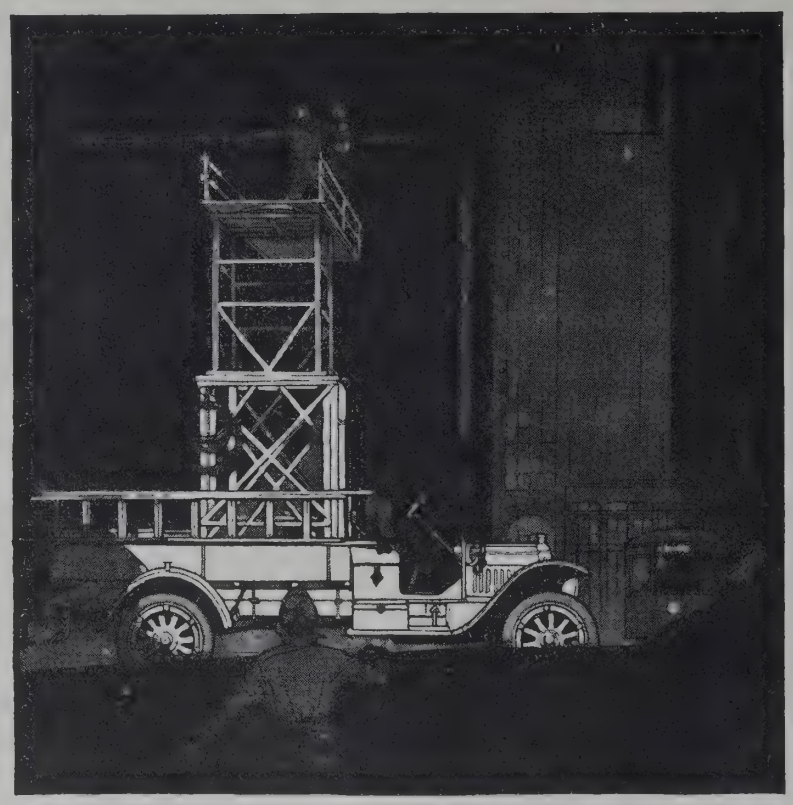

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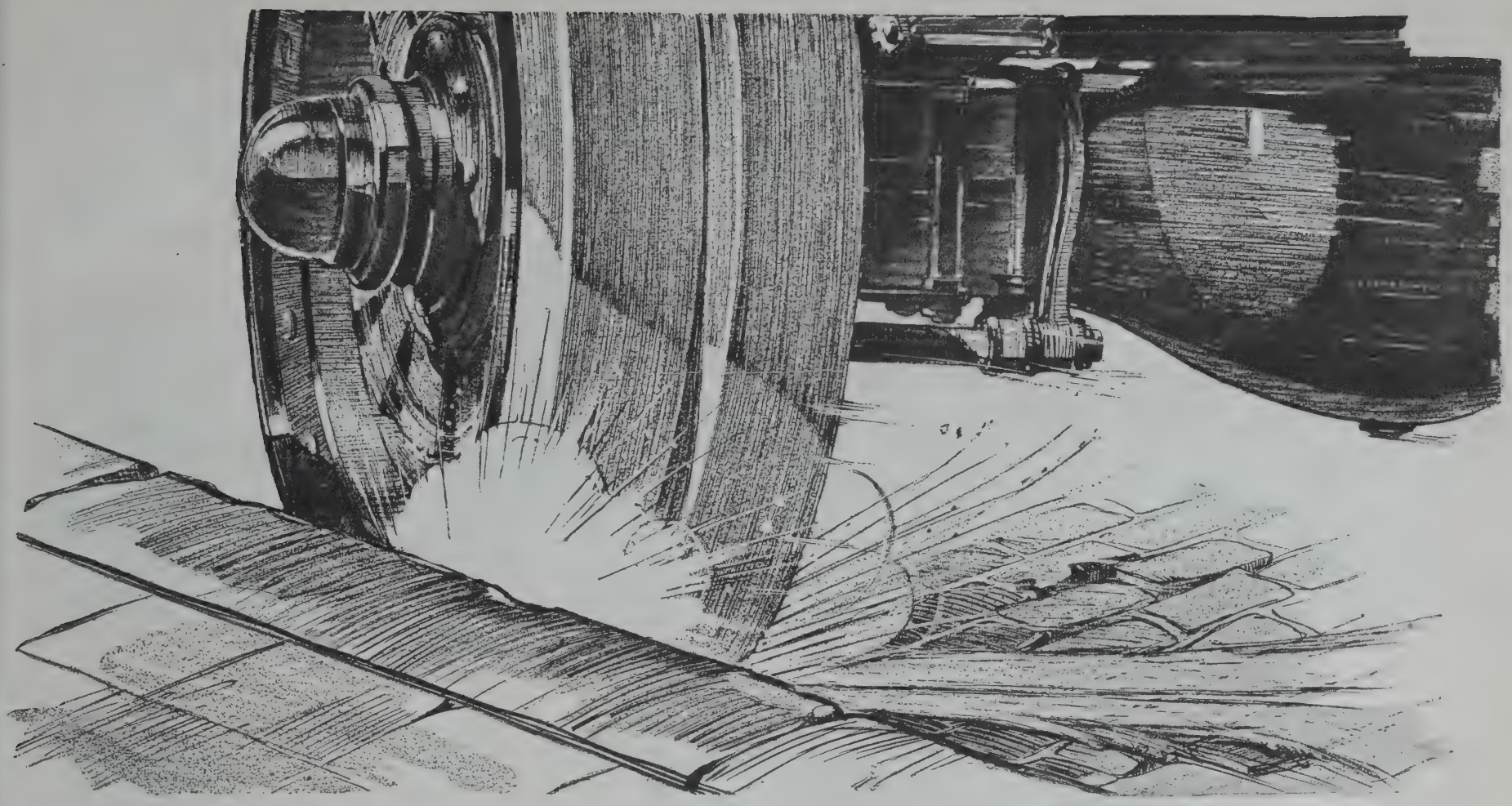
# WHITE TRUCKS



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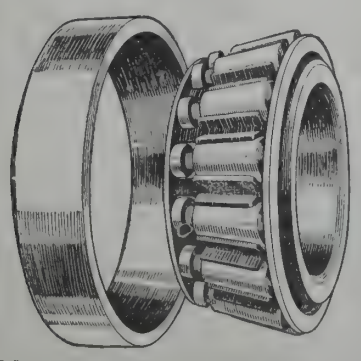

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THE SCIENTIFIC AMERICAN, December 4, 1920. Volume 123, Number 23. Published weekly by Scientific American Publishing Company at 233 Broadway, New York, N. Y. Subscription price, $6.00 per year
Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879.

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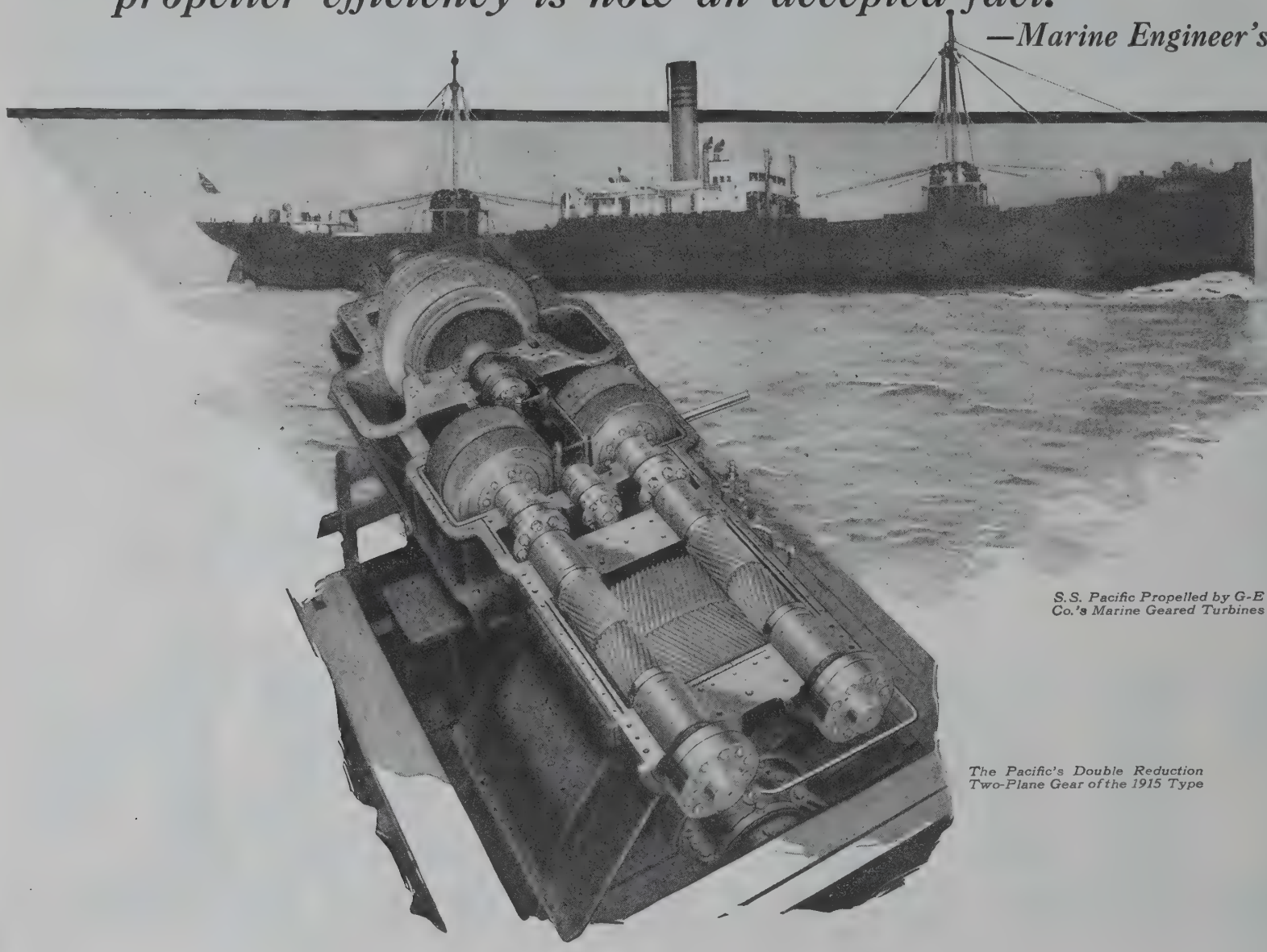

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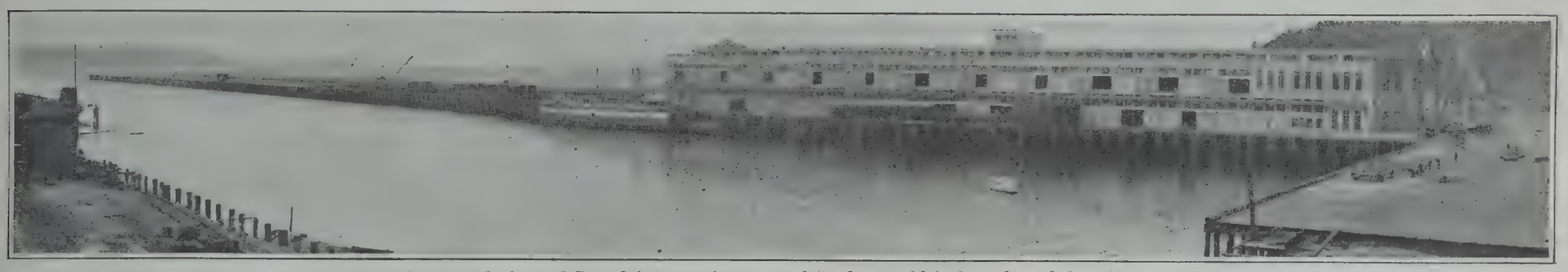


A general view of Seattle's new pier, second in the world in length and first in area

## Seattle's Record Pier

**By Ralph Howard**

THE Port of Seattle's new Smith's Cove Terminal Pier "B" is completed, and the fact that the port has made arrangements with two of the largest steamship companies on the Pacific Coast for the use of this terminal, shows the need of such a facility.

This pier is 367 feet wide and 2,560 feet long, only lacking 60 feet of being a half mile. It is the largest commercial pier in the world, even surpassing in square foot area the huge Chicago Municipal pier, which is 3,000 feet long.

This pier will have two transit sheds, 130 feet wide by 1,000 feet long at the street end, the outer section of the pier being uncovered, and given over for the handling of export freight. The north 500 feet of the east transit shed has been finished and as the construction crew were leaving the work, the "Horaisan Maru" began discharging 10,000 tons of cargo, consisting of nitrates, sugar, etc., into the transit shed for transshipment. Bids were requested for the construction of the north 500 feet of the west transit shed; these proposals were opened August 25, 1920, and the work contracted for at that time.

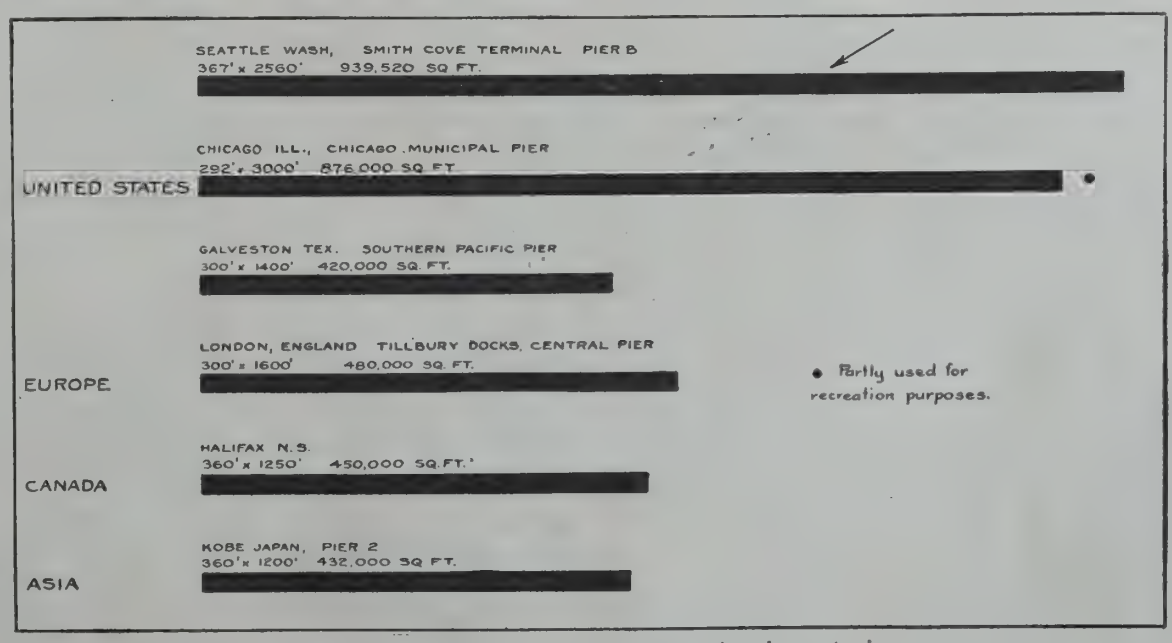
One of the outstanding features in connection with the equipment of this pier is the amount of railroad trackage, there being approximately 4½ miles of trackage consisting of two shipside tracks on outer sides of pier, together with four depressed tracks in the center, with numerous cross-overs in order to facilitate switching. It was decided to install this great amount of trackage since very satisfactory results have been obtained in the operation of the similar Smith's Cove Pier "A," which has 3½ miles of railroad trackage.

The port of Seattle has made satisfactory arrangements with the largest American steamship company on the Pacific Coast, and the largest Japanese steamship company entering Puget Sound for the use of Pier "B," the former being given preferential right for the use of the east side of the pier, while the latter has been given preferential right for the use of the west side of the pier. It is understood, of course, that when the ship berths and storage space are not used by either of these companies, the Port Commission will have the right to berth other ships and use storage space as required in order to place the terminal in maximum use.

Elaborate passenger accommodations and baggage inspection rooms are to be installed on the second floor at the street end of each shed for the accommodation of transpacific passenger traffic. A large commodious waiting room will be located on the water side of the second floor of each shed, this location being an ideal one from a fire hazard standpoint, besides giving the passengers easy access to the street. Just opposite and on the other side of the shed will be located the baggage inspection room, thus making it very convenient for the passengers.

Along the face of the pier, portable adjustable ramps will be provided, allowing passengers to leave the ship and enter the second floor in close proximity to the waiting and baggage rooms on an easy grade and without crossing any railroad tracks on the same level. The portable ramps will be made adjustable for any stage of the tide and will be electrically operated, making their operation simple and economical. Overhead bridges will be installed connecting the second floor of transit sheds with the overhead Garfield Street viaduct, enabling passengers to reach the street on the same grade, avoiding congestion of railroad and vehicular traffic on the lower floor from the time they leave the ship until they reach the street car line, taxicabs or waiting automobiles on West Garfield Street.

Since the oriental passenger boats also carry a large amount of freight, Smith's Cove Pier "B" will be most suitable for this class of business, for the import cargoes can be discharged and stored in the shed at the same time the passengers are leaving. To expedite the handling of this freight in the shed, a great variety of light handling equipment will be furnished. After the ship has discharged her passengers and her import cargo, she can then be warped along the pier to the large open wharf to take on her export cargo. Again, on the open wharf, a great variety of heavy mechanical handling equipment will be provided to expedite the loading of these vessels.




Graphic comparison of some of the world's largest piers

## Where the Lumber Goes

WOOD alcohol, as odious as it now appears in the public eye, has its proper uses. And the effort of the Forests Products Laboratory, Madison, Wis., to improve the quality of the liquid is legitimate—not, however, with the viewpoint of popularizing it as a beverage. Also, grain alcohol may in the future be extracted from waste wood accumulating around the sawmill or from scraps salvaged around newly-constructed houses.

From woodland to the bungalow in which you live, more than 60 per cent of the timber supply cut goes to waste, each of the transforming processes taking its toll of extravagance. How to utilize this large waste material is taxing the ingenuity of forest experts—the range of conservation involving anything from perfecting a better quality of wood alcohol to a baseball bat made from scrap lumber. Emphasizing the importance of recovering the huge timber waste, from the time it is felled in the forests until the last nail rivets the woodwork in the new house, the United States Forest Service has designed a unique model.

Situated on this diminutive scale of operations are representations descriptive of the successive stages through which timber passes—a growth of uncut trees, sawmill, planing mill, wood-working establishment, tanning factory, and a newly built home. Descriptive text is accessible to indicate the estimated percentage of loss credited to each of the varying processes of converting the trees into usable material.

At the fountain source of our timber resources—the growing woodlands—16 per cent is squandered in tops, limbs and stumps; 10 per cent is represented in edgings and trimmings; sawdust takes a toll of nearly 11 per cent; 10 per cent is wasted in slabs; bark represents nearly 11 per cent of waste; something over 5 per cent is lost in seasoning; careless manufacturing ioses 2½ per cent, while the planing mill renders irrecoverable still another small increment of something in excess of one per cent.—By *S. R. Winters.*

# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Choosing a Secretary of the Navy

THE Navy has passed through more than one crisis in its history, and it is passing through a crisis today. The causes are many, and prominent among them are the policies, and even more, the mental attitude and outlook of the man who has filled the position of Secretary of the Navy for the past eight years. Selected for the position, apparently because of his out-and-out political sympathies, he found himself, on taking office, at the head of a vast and complicated institution of which technically he knew very little, if anything at all. With the spirit and traditions of the Navy, in their deeper and more spiritual significance, he seemed, from the very first, to be utterly out of touch—an estrangement, alas, which the passage of the years has seemed rather to accentuate than diminish.

And now we are to have a new Secretary, whose duty it will be to conserve the best of what the preceding administration has secured, and repair what many men within the Navy will tell you is the irreparable damage which has been wrought during the past eight years upon the traditions, the morale and the teamwork of the Navy as a whole. We believe that the following suggestions, as a basis of choice will commend themselves to those who have the highest interests of the Navy at heart.

In the first place, the Secretary should be selected as far as possible without any regard to his political color. We want no repetition of Danielsism. The Secretary's first thought and his last must be, not how this or that measure affects his political party, but how will his policies help to build up the Navy and make it a more effective instrument of defense?

Secondly, the new Secretary should have some knowledge of the Navy and its work, such, for instance, as was possessed by Mr. Daniels' able coadjutor, Mr. Franklin D. Roosevelt. Unless a man has had sufficient interest in naval affairs to possess himself of some knowledge of the history of the Navy, its present international standing and the functions of the various types of warships, he should be passed by. There are several men in political life who are qualified in this respect. They can be found in the naval committees both of the House and the Senate. Some, indeed, such as Senator Weeks, have passed through Annapolis and are thus admirably furnished to grapple with the questions of policy, personnel and materiel. It is a monstrous absurdity that a new Secretary should be so ill-informed as to have to learn the elements of the naval game at the very time when he is called upon to make decisions on the complicated questions which crowd in upon him from the very day that he enters upon his duties.

In handling the personnel of the Navy, the Secretary should play no favorites. He should be sympathetic alike with the officers and the men. He should have a full appreciation of the high code of ethics which is instilled into our young officers at Annapolis and which, we are happy to believe, maintains an ever-strengthening influence as they pass up to the higher grades. Nothing has been so disastrous in its effect upon the Navy as the belief which has grown up during the past eight years, that the present Secretary never grasped the meaning of that phrase: "As an officer and a gentleman." Whether the charge is justly laid at his door or not, we leave it to the impartial judge of his record to determine for himself. On the other hand, the enlisted men must feel that they have in the Secretary a staunch friend, who stands ready at all times to safeguard their interests, promote their material comfort, and hold open the door of opportunity. In this last regard the Secretary has done good work.

Lastly, since not even the State Department is brought into a more intimate touch with the outside world than is the Navy, the Secretary should be a man of wide international outlook and free from petty traditional dislikes and prejudices. He should understand that it is possible for an officer to give generous praise in recognition of the work of an ally, without incurring suspicion that he is lacking in true Americanism. True Americanism stands for Mr. Roosevelt's "square deal." It believes that a demand for the recognition of the rights of the people whom the Navy safeguards, is compatible both with the full recognition of the rights of others and a frank acknowledgment of their achievements in a common cause.

## Chess by Infants

CURRENT news relates the exploits of the eight-year-old Samuel Rzechewski, who has come out of Poland to conquer the world of chess. First-class players succumb to him; he gives simultaneous exhibitions against twenty average players with complete success; and Capablanca, at worst the world's second player, estimates that the United States may hold six men capable of giving him an even fight.

Chess has always been held up as the game of intellect par excellence; it has been taken for granted that only a rare combination of the highest mental abilities can qualify a man to play it with extreme skill. People who would realize that an infant prodigy in other lines is explainable on rational grounds are apt to be swept off the plane of common sense in discussing a Rzechewski or a Morphy.

The public at large and the mediocre player have little conception of the mental processes by which the masters of this game attain their results. Six years ago, in the Brooklyn-Washington telegraph match, one of the Brooklyn players undertook at about the twelfth move what appeared to be a highly hazardous sacrifice of a piece. A near-master in the gallery, a man whose journalistic activities are so heavy as to preclude his being among the very top-notchers of the game, spoke about as follows:

"That is the continuation employed by Blank against Dash at Hastings in 1896. In that game black defended so"—setting up the pieces on an idle board and running through the eighteen-year-old game from start to finish, never at a loss for the next move.

Turn from this scene to the rooms of the Manhattan or Brooklyn or Rice Chess Club, where we shall always find a gathering of the notable characters of metropolitan chess; and let us listen to the comments here made on a game in progress. Seldom do these comments take the form "If he goes here, black goes there; then white plays so and black so. . . ." Rather do we hear remarks like these: "But I tell you that *must* be strong—see the command it gives him of white's queen side"; or "Ach, he should have pushed the bishop pawn and built up his center"; or "What does he threaten? We have time for a developing move"; or "The isolated pawn ought to lose, in spite of the black king's being out of play."

The possible ramifications of any ordinary position in this game are well nigh infinite. Anderssen, one of the classical masters, in response to direct inquiry, said that when he was very fortunate he could see into the game as far as two moves. The good player does not analyze move by move, save in exceptional cases. His ability rests on two things. He remembers thousands of games that have been played by himself and others; thousands more of positions that are apt to be more or less closely approximated in actual play. He possesses the knack of putting out of his mind all other things when he is playing chess, and so doing he is able to master his memory and make it reveal to him in a flash the one game or the one position in all these thousands that throws light on the position before him. That is all there is to it.

Memory and attention do the trick. Memory is as likely to be found highly developed in a juvenile as in an adult. And once you get a juvenile with strong memory interested in chess, you have a strong player—for his experience gives him few things to conflict for attention with the board and men before him. All the amount of reasoning and analysis in the world are as nothing in the presence of the man who *knows* that in positions resembling this one the correct move is to occupy the open file with the rook or to post the knight on bishop's fourth, who can call to mind the complete course of a dozen games sufficiently similar to the present one to be a valid guide. That is the stuff of which chess prodigies, boy or man, are made.

## Our Engineers and the Public Service

AT the signing of the armistice the question arose as to how far it would be possible to make permanent the war organization of the engineers of the United States and render it effective in times of peace; and, as a result of a call to assemble and debate the matter in Washington, there was an enthusiastic response, which resulted in the formation of the Federated American Engineering Societies.

That the underlying purposes of this great and influential body include no narrow or selfish aims is shown by the following extract from the preamble: "As service to others is the expression of the highest motive to which men respond, and as duty to contribute to the public welfare demands the best efforts that man can put forth, now, therefore, the engineering and allied technical societies of the United States of America, through the foundation of the Federated American Engineering Societies, realize a long cherished ideal—a comprehensive organization dedicated to the service of the community, State and Nation."

At a meeting of the Federated American Engineering Societies held on August 18 at Washington there was launched the American Engineering Council of the Federated Societies, which henceforth will voice the aims of the united engineering forces in furthering a great national program of public service. The program proposes the following activities:

To devote itself to the conservation of our national resources, particularly in coal, oil, timber and water power. It proposes also to apply itself, immediately, to the great national problem of transportation, not only by rail, river and ocean, but by various subordinate but rapidly developing means of transportation.

It will take hold of the question of industrial relations between capital and labor, a matter regarding which the engineer, because of his comparatively impartial point of view, is believed to be especially equipped to make recommendations. We may remark here that by virtue of his very position, he stands midway between the two elements which too often in the past have regarded each other with suspicion and distrust. The engineer of necessity has to be in close touch with capital. On the other hand, to be successful, he must have a sympathetic understanding of contractors, foremen and so-called common labor.

Another movement to which the Engineering Council will devote itself is that of the creation of a national public works department by means of a reorganization of the Department of the Interior. Here is another question on which, by virtue of thorough experience, the engineers of the country are peculiarly qualified to plan and advise. Of prime importance, also, is the recommendation that the Engineering Council should guide legislation in the matter of licensing and registration of engineers. In view of the magnitude and costliness of engineering works, and particularly in view of the degree to which public convenience and safety depend upon good engineering, we consider this matter of licensing and registration to be of fundamental importance. Under the present system, too many half-trained and ill-adapted young men are passed on into this profession, with results which are injurious to the public and to the engineering profession alike.

Not the least important work of the council will be to coöperate with the Drafting Bureau of Commerce in its work of preparing for a national budget system and other important legislation. No one is better qualified to make estimates of cost than the engineer, or so quick to throw out proposals of national magnitude which are visionary and doomed to ultimate failure.

# That Parallel Postulate

## The Dividing Line Between Euclidean and Non-Euclidean Geometry, and What the Latter Means

### By The Einstein Prize Essay Editor

POINT, line and plane Euclid attempts to define. Modern objections to these efforts was made clear in our article of Sept. 18th. Against Euclid's specific definitions we urge the further specific fault that they are really assumptions bestowing certain properties upon points, lines and planes. These assumptions Euclid supplements in his axioms; and in the process of proving propositions he unconsciously supplements them still further. This is to be expected from one whose justification for laying down an axiom was the alleged obvious character of the statement made. If some things are too obvious to require demonstration, others may be admitted as too obvious to demand explicit statement at all.

Thus, if Euclid has two points A and B in a plane, on opposite sides of a line M, he will draw the line AB and without further formality speak of the point C *in which it intersects* M. That it does so intercept M, rather than in some way dodges it, is really an assumption as to the nature of lines and planes. Or again, Euclid will speak of a point D on the line AB, between or outside the points A and B, without making the formal assumption necessary to insure that the line is "full" of points so that such a point as D must exist. That such assumptions as these are necessary follows from our previous remarks. If we think of our geometry as dealing with x's, y's and z's, it is no longer in the least degree obvious that the simplest property applies to these elements. If we wish any property to prevail we must state it explicitly.

With the postulates embodied in his definitions, those stated in his axioms, and those which he reads into his structure by his methods of proof, Euclid has a categorical set—enough to serve as foundation for a geometry. We may then climb into Euclid's shoes and take the next step with him. We follow him while he proves a number of things about intersecting lines and about triangles. To be sure, when he proves that two triangles are identically constituted by moving one of them over on top of the other, we may protest on the ground that the admission of motion, especially of motion thus imposed from without, into a geometry of things is not beyond dispute. If Euclid has caught our modern viewpoint, he will rejoin that if we have any doubts as to the admissibility of motion he will lay down a postulate admitting it.

Having exhausted for the present the interest of intersecting lines, our guide now passes to a consideration of lines in the same plane that never meet. He defines such lines as parallel. If we object that he should show the existence of a derived concept like this before laying down a definition that calls for it to exist, he can show that two lines drawn perpendicular to the same line never meet. He will execute this proof by a special sort of superposition, which requires that the plane be folded over on itself, through the third dimension of surrounding space, rather than merely slid along upon itself.

We remain quiet while Euclid demonstrates that if two lines are cut by *any* transversal in such a way as to make corresponding angles at the two intersections equal, the lines are parallel. It is then in order to investigate the converse: if the lines are parallel to begin with, are the angles equal?

#### Axioms Made to Order

This sounds innocent enough; but in no way was Euclid able to devise a proof—or, for that matter, a disproof. So he took the only way out, and said that if the lines were parallel, obviously they extended in the same direction and made the angles equal. The thing was so obvious, he argued, that it was really an axiom and he didn't have to prove it; so he stated it as an axiom and proceeded. He didn't state it in precisely the form I have used; he apparently cast about for the form in which it would appear most obvious, and found a statement that suited him better than this one, and that comes to the same thing. But wisely enough, he did not transplant this axiom, once he had arrived at it, to the beginning of the book where the other axioms were grouped; he left it right where it was, following the proposition that if the angles were equal the lines were parallel.

This of course was so that it might appeal back to the demonstrated proposition for its claim to obviousness.

Euclid must have been dissatisfied with this cutting of the Gordian knot; his successors were acutely so. For twenty centuries the parallel axiom was regarded as the one blemish in an otherwise perfect work; every respectable mathematician had his shot at removing the defect by "proving" the objectionable axiom. The procedure was always the same: expunge the parallel axiom, in its place write another more or less "obvious" assumption, and from this derive the parallel statement more or less directly. Thus if we may assume that the sum of the angles of a triangle is always exactly 180 degrees, or that there can be drawn only one line through a given point parallel to a given line, we can prove Euclid's axiom. Sometimes the substitute assumption was openly made and stated, as in the two instances cited; as often it was admitted into the demonstration implicitly. But such "proofs" never satisfied anyone other than the man who made them; the search went merrily on for a valid "proof" that should not in substance assume the thing to be proved.

#### Locating the Discrepancy

Saccheri, an Italian Jesuit, would have struck bottom if he had had a little more imagination. He gave an exhaustive *reductio ad absurdum*, on the basis of the angle-sum theorem. This sum must be (a) greater than or (b) equal to or (c) less than 180 degrees. Saccheri showed that if one of these alternatives occurs in a single triangle, it must occur in every triangle. The first case gave little trouble; admitting the possibility of superposing in the special manner mentioned above, which he did implicitly, he showed that this "obtuse-angled hypothesis" contradicted itself. He pursued the "acute-angled hypothesis" for a long time before he satisfied himself that he had caught it, too, in an inconsistency. This left only the "right-angled hypothesis," proving the Euclidean angle-sum theory and through it the parallel postulate. But Saccheri was wrong: he had found no actual contradiction in the acute-angled hypothesis—for none exists therein.

The full facts were probably first known to Gauss, who had a finger in every mathematical pie that had to do with the transition to modern times. They were first published by Lobatchewsky, the Russian, who anticipated the Hungarian John Bolyai by a narrow margin. All three worked independently of Saccheri, whose manuscript turned up only in recent years.

Like Saccheri, Lobatchewsky investigated alternative possibilities. But he chose another point of attack: through a given point it must be possible to draw, in the same plane with a given line (a) no lines or (b) one line or (c) a plurality of lines, which shall not meet the given line. The word parallel is defined only in terms of the second of these hypotheses, so we avoid it here. These three cases correspond, respectively, to those of Saccheri.

The first case Lobatchewsky ruled out just as did Saccheri, but accepting consciously the proviso attached to its elimination; the third he could not rule out. He developed the consequences of this hypothesis as far as Euclid develops those of the second one, sketching in a full outline for a system of geometry and trigonometry based on a plurality of "non-cutters." This geometry constitutes a coherent whole, without a logical flaw.

This made it plain what was the matter with Euclid's parallel axiom. Nobody could prove it from his other assumptions *because it is not a consequence of these.* True or false, it is independent of them. Trinity Church is in New York, Faneuil Hall is in Boston, but Faneuil Hall is not in Boston *because* Trinity is in New York; and we could not prove that Faneuil Hall was in Boston if we knew nothing about America save that Trinity is in New York. The mathematicians of 2,000 years had been pursuing, on a gigantic scale, a delusion of *post hoc, ergo propter hoc.*

#### What the Postulate Really Does

Moreover, in the absence of an assumption covering the ground, we shall not know which of the alternatives (a), (b), (c) holds. But when one holds in a single case it holds permanently; so we cannot proceed on this indefinite basis; we must know which one is to hold. Without the parallel postulate or a substitute therefor that shall tell us the same thing or tell us something different, we have not got a categorical set of assumptions—we cannot build a geometry at all.

The reason why it took so long for this to percolate into the understanding of the mathematicians was that they were thinking, not in terms of the modern geometry and about undefined elements; but in terms of the old geometry and about strictly defined and circumscribed elements. If we understand what is meant by Euclidean line and plane, of course the parallel postulate, to use the old geometer's word, is true—of course, to adopt the modern viewpoint, if we agree to employ an element to which that assumption applies, the assumption is realized. The very fact of accepting the "straight" line and the "flat" plane of Euclid constitutes acceptance of his parallel postulate—the only thing that can separate his geometry from other geometries. But of course we can't prove it; the prior postulates which we would have to use in such an attempt apply where it does not apply.

To all this the classical Euclidean rejoins that we seem to have in mind elements of some sort to which, with one reservation, his postulates apply. He wants to know what these elements look like. We can, and must, produce them—else our talk about generality is mere drivel. But we must take care that the Euclidean geometer does not try to apply to our elements the notions of straightness and flatness which inhere in the parallel postulate. We cannot satisfy and defy that postulate at the same time. If we do not insist on this point, we shall find that we are reading non-Euclidean properties into Euclidean geometry, and interpreting the elements of the latter as straight lines that are not straight, flat planes that are not flat. It is not the mission of non-Euclidean geometry thus to deny the possibility of Euclidean geometry; it merely demands a place of equal honor.

#### The Geometry of Surfaces

Let us ask the Euclidean geometer whether he can recognize his plane after we have crumpled it up like a piece of paper en route to the waste basket. He will hesitate only long enough to recall that in the special case of superposition he has reserved for himself the privilege of deforming his own plane, and to realize that he can always iron his plane out smooth again after we are through with it. This emphasizes the true nature of the two-dimensionality which is the fundamental characteristic of the plane (and of other things, as we shall directly see). The plane is two-dimensional in points *not* because two sets of mutually perpendicular Euclidean straight lines can be drawn in it defining directions of north-south and east-west, but because a point in it can be located by means of two measures. The same statement may be made of anything whatever to which the term "surface" is applicable; anything, however crumpled or irregular it be, that possesses length and breadth without thickness. The surface of a sphere, of a cylinder, of an ellipsoid, of a cone, of a doughnut (mathematically known as a torus), of a gear wheel, of a French horn, all these possess two-dimensionality in points; on all of them we can draw lines and curves and derive a geometry of these figures. If we get away from the notion that geometry of two dimensions must deal with planes, and adopt in place of this idea the broader restriction that it shall deal with surfaces, we shall have the generali-

(*Continued on page 579*)

*OUR intuitions, if we give them free rein, will accept Euclidean geometry as the absolute truth about the space in which we are immersed. But in our article of September 18th we saw that no geometry can be the absolute truth about anything. The most that can happen is that a given set of objects, real or conceptual, constitute a realization of the geometry. To understand clearly the limitations of Euclid's geometry, we must go back and put ourselves in Euclid's shoes —as far as this can be reconstructed, in Euclid's very frame of mind. And let it be understood that the Euclidean geometry of this discussion is the scientific structure of a Euclid, a Klein or a Hilbert—not the pedagogic one of a Wentworth and a Smith with which most of us are better acquainted.*—THE EDITOR.

# Illiterate Adults

## Our Growing Population That Reads and Writes in Other Languages or None at All

By Winthrop Talbot, M.D.

**Men unable to read or write in any language, receiving instruction at the expense of their employer**

IN this country each year a million boys come to be 18 years of age. One hundred thousand of them have never had any schooling at all. They are technically illiterate. Illiteracy may be defined as inability to read or write in any language, and this definition applies throughout the following article. It should be understood that statistics of adult illiteracy deal only with persons who are over 14 years of age and who are beyond the obligatory school age. In addition to the one hundred thousand technical illiterates, two hundred thousand more have not had more than two years of schooling or three hundred and twenty days and about half of them have had but one year or 160 days of attendance at school. These two hundred thousand boys are practically illiterate for they have left school so young that as men they have retained but little of their schooling. More than half of the million barely reach the sixth grade, and a scant hundred thousand ever get as far as high school.

Nineteen States do not require the full school year of 200 days. Eight States require less than one hundred days. The average school year is only 163 days. One State has failed until now to make any schooling obligatory.

Less than ten per cent of all males get any kind of vocational or trade training at school. Fifty thousand of our million 18-year-olds do not speak any English at all. Among the million youths physical defects are general, due in large measure to ignorance. Two hundred thousand of the million would be rejected as unfit to serve the country because of extreme physical, moral, or mental defects. We certainly cannot congratulate ourselves upon any alarmingly high standards or effective results in our schooling of youth in America thus far.

How is it with our foreign adults and negroes and native whites? In 1910 we had five and a half million (5,516,163) persons who could not read a word in any language. Of these a million and a half were foreign-born. Now in 1920 we have nearly two million and a half illiterate aliens who cannot read a word even in their own languages. For example, from 1910 to 1914 inclusive, we admitted 971,366 immigrants from southern Italy and of these 415,806 or 49 per cent could not sign their names or read even the simplest Italian words. These are technical illiterates, but almost all Armenians, Turks, Russians, Bulgarians, Ukrainians, Croats, and Yiddish speaking peoples come practically illiterate to America, even though they may be able to read and write in their own languages, because their script and printed letter forms are quite different from ours.

The near-illiterate or those who can barely write their names and who decipher words only with difficulty are nearly four times as numerous as the technically illiterate. If now we take into consideration our negro population and unschooled native whites, it is easily grasped that in our total population we are all seriously handicapped by the intellectual dependency and mental pauperism of one quarter of our American population. This vast number, more than twenty-five millions, is cut off from ability to share properly in our national life. They form the drag on labor. They contribute mainly to our defective and criminal classes. They are the "examples" of our radical agitators.

Seventy per cent of industrial accidents occur to persons who require the services of an interpreter in presenting their claims. In most cases those who are injured are unable to read even a danger sign. In New York State alone from 1915 to 1918 accidents in industry have averaged 274,763 annually. In other words the number of industrial accidents averaged more annually than the total casualties of the American Expeditionary Force. The figures are as follows: 1915, 225,391; 1916, 273,385; 1917, 313,406; 1918, 286,871. At present industrial accidents are reported at the rate of approximately a thousand a day every working day in the year in this one State. This represents an initial expenditure of $13,000,000 a year for compensation. If we add to this the cost of medical benefits, administration of the compensation law, wages and cost of turnover, the total is about $25,000,000 yearly or $80,000 a day for accidents only to those who do not understand the American language.

This is the accident cost of the illiterate in this one State alone. What is true of the State of New York is also true of the whole manufacturing belt of the North, as well as of mining States such as West Virginia, Colorado, and Idaho. Thus a quarter of a million dollars a day is a moderate estimate of the cost of the illiterate to industry in the United States for accidents only, due in large measure to inability to read a danger sign or to understand ordinary safety instructions, and because of lack of a common language.

It is generally known that steel and coal strikes with their attendant loss of production and wage, as well as strikes occurring in other industries employing large numbers of foreigners are fomented readily because of inevitable misunderstandings due to diversity of speech. In many industrial plants twenty or more races of men are employed speaking as many languages, unable to read common work notices, and thus incapable of ready assimilation or industrial teamwork.

During the fifteen years from 1900 to 1914 inclusive, the total number of immigrants to the United States beyond school age, that is, over 14 years of age, was nearly twelve million (11,726,606). Of this number more than three million (3,116,182) could not decipher a word in their native tongue and practically all

(*Continued on page 580*)

*THE tremendously increased opportunities for acquiring the rudiments of an education today, as compared with a century ago, more or less, are apt to blind us to the necessity of some steps that shall insure the utilization of these advantages by the maximum proportion of the population. We take it for granted that everybody can and therefore that everybody does learn to read and write. The experience of those in charge of the great draft-act administration was perhaps the first suggestion that there exists in our midst a body of men and women aggregating ten per cent of the whole who can not read or write in any language. Dr. Talbot, as the author of several Federal bulletins on the situation and one who has dealt with it in public schools and industrial plants, is well qualified to tell us the extent and seriousnesss of this problem.*—THE EDITOR.

*Standing:* Serb, Swede, Bohemian, Slovene, Slovak, German, Lithuanian, American Negro. *Sitting:* Russian Jew, German Pole, Russian Pole, Austrian Pole, Italian, Greek

**A representative group, not selected, from a Workers' Public School in a tannery. Fourteen men of fourteen races, unable to read English**

*Left:* A truck that was used to do all the hauling for a mountain orchard, and that came through with flying colors. *Right:* Using a motor truck to deliver manure to the point of final deposit

**Two of the many tasks which a motor truck can perform cheaply and efficiently for the orchardist**

## Motor Trucks in Orchards

**By Arthur L. Dahl**

NATURE is slow in growing to maturity fresh fruits, but once they have reached that state of perfection they deteriorate more or less rapidly, and the greatest task of the orchardist is in marketing his fruit crop in the quickest possible time and with the least amount of spoilage.

The time of harvest for most fresh fruits is limited to a month or so, and the most bountiful crop will not put dollars in the bank unless the fruit is delivered to a buyer in good condition; and in aiding the fruit grower to harvest all of his crop and make delivery to the purchaser in the best possible condition, the motor truck is playing an important part in all sections of the country.

In modern times a large proportion of the fruit grown in many sections of our country is sold to canneries, and these canneries have very strict and rigid standards for fruit, and the prices paid for deliveries made by orchardists are based upon those standards. In too many cases fruit growers living some miles from the cannery have left home with a load of fresh fruit in good condition, but on account of the heat of the sun and the length of time required to reach the delivery point with a team, the freshness of the fruit was largely lost and the owner was severely penalized for this condition. Now this orchardist may have devoted as careful and intelligent attention to the production of that fruit crop as any of his neighbors, but because his transportation facilities were slow and inadequate, he suffered the loss of a large share of the profit he should have had.

The first point of superiority of trucks for orchard use is speed in making deliveries. A truck, even though loaded to capacity, can make better time than horse-drawn vehicles, and in the movement of a large tonnage of perishable fruit, this might mean the handling of double the amount of fruit in the same time, compared to horses. The saving in time in making deliveries is in proportion to the distance hauled, for the longer the haul the more time saved, for the truck can maintain a steady speed over the entire distance and keep it up for many round trips, while horses naturally tire.

As an example of the time saved in using trucks for delivering fruit the following experience was related by one of the owners of the Harrison Nurseries, of Berlin, Md.

"We use our trucks in transporting fruit, particularly peaches, from orchards to our packing plant. Peaches must be handled quickly, and it is also important that we make our schedule with the railroads. At packing time we employ from 100 to 125 people, whose work is directly dependent upon our trucks. Recently one of our motor trucks enabled us to transport a force of men from Berlin to Easton, 75 miles away, pick $16,000 worth of peaches and return in six days. Another of our trucks this season made thirteen trips in one day between one of our orchards and our packing plant, a distance of two miles, carrying 175 baskets of peaches on each trip, besides two other trips carrying employees."

Another peach grower reported that in the old days when he used a team he had to start for market, 10 miles away, between 12 and 2 A. M. and got back toward noon. The trip with the wagon had to be very slow to prevent bruising. Now, however, with an auto truck equipped with good springs, shock absorbers and pneumatic tires, the most delicate peaches are carried into market within an hour, and other stuff in half the time. He starts out at 5 A. M., is unloaded at market by 6, and is back at the farm a little after 7, with the whole day ahead of him for other work.

Motor trucks not only enable the fruit grower to haul his crop in less time, but he can haul a great deal more to a load than with any other mode of conveyance. This means that in many cases the truck will handle in one load what would have been two or more loads with a team, and in this day of labor shortage this is an important advantage.

California is a great fruit country, and there are some very good roads there, so it is to be expected that motor trucks should readily demonstrate their carrying capacity there to the best advantage. There are hundreds of examples of enormous loads of fresh fruit hauled from one point to another in California, but a representative one is the experience of a Santa Clara orchardist who hauled, on a motor truck and a trailer, 16,000 pounds of fresh apricots from his orchard to the cannery, a distance of six miles. A part of this haul was made over the soft ground of an orchard before the county road was reached, but this outfit operated throughout the picking season and never gave any trouble.

Throughout the various fruit districts of California motor trucks can be seen engaged in doing all kinds of work from hauling manure to fertilize the soil to hauling the fruit crop to market. Many owners have several types of bodies for their trucks, so that they can

(*Continued on page 581*)

**A gang of moldboard plows at work in a California orchard, preparing the ground for a cover crop that conserves the moisture and furnishes a rich supply of fertilizer when ready to be plowed under**

## Cover Crops for Our Orchards

**By H. A. Crafts**

THE use of cover crops in California orcharding is very important to successful culture, and its value is being better appreciated the more it is practiced. Climatic conditions are among those entering into the problem. The rainless summers of California render conservation of moisture very essential to the production of any crop whatever. And it is just as essential to a full fruit crop as to any other.

Cover crops may be made to conserve moisture in more than one direction.

Shading, mulching, and cultivation may be mentioned as being among these.

The benefits of cultivation, of course, accrue automatically. You cannot very well raise a cover crop without first plowing the ground, harrowing, cultivating, disking it; and all this stirring of the soil tends strongly to conserve moisture. Well-plowed and cultivated ground lies in the best shape possible to receive, retain and distribute the moisture resulting from current rainfall. It also stimulates the rise of the hidden moisture, stored in the sub-strata of the soil. Thus it aids the accumulation of necessary moisture from two opposite directions, and thus seems to exercise a most valuable and well-ordered function.

Again, a cover crop provides a very feasible method of refertilization. For the crop, in its state of fullest maturity, may be plowed under, and made to supply that very necessary substance to the soil, known to science as humus, but which in plain, unvarnished English means simply vegetable matter in process of decomposition.

The ancient illusion under which some orchardists labor, even at this late day, that a fruit tree that once germinates, springs up, flourishes and produces fruit, is a permanent institution; and that the principal duty of the orchardist is simply to harvest a crop of fruit, year by year, from these permanent trees, seems to be slowly vanishing from pomological psychology. The truth of the matter is that the fruit tree should be nursed and nourished and fostered even much more faithfully than a mere annual crop of corn, or potatoes or beans. This because the fruit tree stands guard ceaselessly, night and day, summer and winter, in sunshine or rain, being exposed to the constant play of the elements, the assaults of disease and pestiferous insects, and so forth.

The life tenure of the peach tree, the orange tree, or the plum tree is perennial, while that of the stalk of corn is only annual. The stalk of corn germinates, takes root, springs up and flourishes only through the brief period of a seasonal career. About September it has finished its cycle; the farmer comes along with a corn cutter, and the whole life of that stalk ceases, save in the golden kernel which it bestows upon the

(*Continued on page 582*)

# A Railroad to Hudson Bay!

## New Resources in Wheat and Copper That Are Expected to Contribute to Its Support

By Anthony M. Rud

Rebuilding the bridge at Armstrong Lake, destroyed by storm

TWO lines of steel are piercing the heart of the Land of Lobstick and Lode, that musky wilderness stretching north from the Saskatchewan River which since the advent of the white man in the seventeenth century (1670, reign of Charles) has been sacred to Esquimaux, Indians, trappers and traders. The railroad, starting from Le Pas at the junction of the Saskatchewan and Opasquai Rivers, already has driven 359 miles northeastward. Eighty miles more of track, which will be completed before midsummer of 1921, will reach the northern terminus at York Factory (Port Nelson) on Hudson Bay.

A "chechako" in the fullest sense of the word, I have just returned from a journey along this new road, and a trip by paddle and portage over the portion of the right-of-way yet incomplete. If it were not for two very definite reasons I should consider the enterprise the acme of the Quixotic, for no more wild and desolate wilderness exists anywhere between Fort Good Hope (Arctic Circle, long. 130) and Winnipeg, between Halifax and Prince Rupert.

A Canadian wizard of wheat recently has added, to the striking achievements of inventing Kitchener wheat, Improved Marquis, and several lesser varieties, an absolutely new variety of red wheat known as Red Top. With Red Top he has established a world's record of 84 bushels to the acre on his quarter-section experimental farm near Prince Albert, Saskatchewan. This is not the most important quality of Red Top wheat, however, nor is the fact that red wheat always has been the favorite of the flour millers. Red Top matures from ten to fifteen days before Kitchener, Marquis, or any other northern wheat!

The significance of this may not be apparent at first glance to the non-agriculturist, but the story is brief. Frost draws a very definite line in the matter of grain cultivation. One cannot grow wheat north of the line where frost appears before the crop is ripe. Red Top, maturing an average of twelve days earlier than any other variety of wheat, pushes northward the boundary of Canadian wheat lands by at least 125 miles! As wheat is practically the only important crop of northern Canada, it is manifest that the addition of 200,000 square miles or more of fertile land to that territory raising the world's food supply, is a matter transcending in importance what Italy does in regard to Fiume, what the Japanese and Californians decide about immigration, or what the trend of United States' policy in regard to the League of Nations becomes under the new administration. The world must eat.

The relation of this discovery—the result of seven years of continued experiment—to the new Hudson Bay Railway, becomes immediately apparent. For a decade export wheat has been tied up, and made unprofitable at Montreal because of car shortages, vessel shortages, and the piling up of demurrage charges. The Canadian Government, in building the new road from La Pas to Port Nelson is planning to ship *via* Hudson Bay all of central and western Canada's wheat destined for export, thus relieving forever the congestion and obviating the delay. Wheat from the old areas—not even considering that which will be grown on the new 125-mile zone—will be shipped at a saving of from six to fifteen cents a bushel. Seven cents will be the lowest saving on Red Top in the added wheat area.

The figures are plain. The new route will save—outside demurrage charges for delay—the cost of shipping 547 (net) miles from Winnipeg, 650 miles from Regina, 685 miles from Brandon, 1,188 miles from Edmonton, and 1,311 miles from Prince Albert. Each of these cities ships more wheat than all other commodities combined. In the present time of freight car shortage it is not necessary to dwell upon the importance of having thousands more of cars at the disposal of the public; this means the erasing at one sweep of dozens of transportation tie-ups and alibis.

The new wheat zone *must* ship *via* this route, as the net saving in distance varies from 100 to 225 miles more than that mentioned in the above figures.

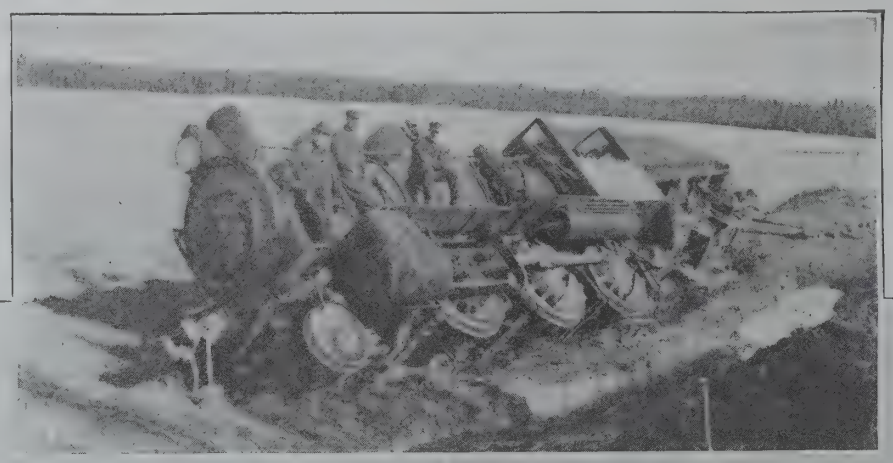
If the new railroad had no other mission it would be of immense importance. As a matter of fact, however, it opens a means of transportation for ore to one of the richest mineral districts in the world.

Herb Lake, Schist Lake and the Flin-Flon region are merely three of a dozen copper, silver and gold properties that are producing right now in prodigal fashion. While the gold and silver as yet have not been discovered in quantities that fade out the Yukon and Cobalt districts, they are being mined with great profit.

Some of the world's richest copper mines, however, lie in the Flin-Flon district. In the States they talk with awe in their voices of Anaconda and other properties which yield from 1.25 to 6 per cent copper ore. *There exist today a half-dozen mines north of Le Pas which are producing ore that yields from 18 per cent upward!* The record, so far as I know, is 21.4 per cent, but the probability is strong that the future will produce even greater yields.

True, there has been grave difficulty with the disposal of mined ore. So far it has been carted overland to Trail, British Columbia, for smelting, and thence clear to Elizabeth, New Jersey, for refining and sale. The new railway, however, will cut out at one swoop half of the expense. A fair fraction of the remainder will be done away with in two years, when smelters and refining plants are erected.

*THE enthusiastic Canadian map-maker has for some years drawn on his charts a dotted line representing a railroad "projected" to give the great inner stretches of the Northwest Territories an outlet to Hudson Bay. But those of us who visualize the northern half of Canada as a land of almost perpetual winter, and Hudson Bay itself as choked with floating icebergs, have always found it difficult to take this "project" seriously. Mr. Rud does not try to disabuse us of any mistaken notions we may have had regarding the summer climate of Canada and the navigability of Hudson Bay—he probably feels that if we don't know about these things we ought to. He does tell us, however, a few things that are news because they are really new, and that have a very large bearing upon the probability of successful operation of the road that is now actually being built to the shores of Hudson Bay.*—THE EDITOR.



1. Starting a portage at Grand Rapids, with the only resident horse north of 55°. 2. A grading difficulty at the present end of the line, Mile 359, north of Le Pas, where the embankment gave way beneath a locomotive. 3. Taking advantage of a breeze on the Nelson River to complete the last lap of the journey to tidewater under present conditions.

**Some glimpses of the country through which the Hudson Bay Railroad will go**

## Boating Without Oars

FROM Germany comes the accompanying photograph, showing a new method of propelling a rowboat. Instead of the conventional oars, this boat is provided with an elaborate system of levers terminating in paddles. By working a lever back and forth, these arms cause the paddles to push the boat along. The paddles may be worked by child or adult, and the operator may sit facing forward or backward, according to his or her preference in the matter.

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**Working the hand lever back and forth propels this boat along at a good clip**

## A New Deal for the Monoplane

AS far as the large passenger-carrying airplane is concerned, the idea that the biplane is the only satisfactory type has been permitted to go unchallenged in most countries. Monoplane design for small, fast machines and biplane design for the large, slow machines, has been the general formula.

But we have not reckoned with Herr Fokker of wartime fame. This veteran Dutch builder of Germany's best fighting machines now comes forward with a passenger carrier of monoplane design which is just as different from anything else as we would expect from a man who has always arrived at his remarkable results in his own individual way. The latest Fokker creation, which is shown in the accompanying illustration, is the type "F-11," built in the new Fokker works at Amsterdam. This machine is one of two monoplanes to be used on the Amsterdam-London air service, which will ultimately be linked up with the service to Bremen, Hamburg and Copenhagen.

The machine is a monoplane of the cantilever type, with a wing that is very thick in the center and tapers toward the tips. The covering is of three-ply wood, which, if not too heavy, should prove very serviceable in this instance. The large wing is placed on the roof of the cabin, and is held in place by four bolts only, one on each side at the top longeron, and at the apex of each set of three struts running from the bottom of the fuselage. Balanced ailerons of small area are fitted to the tips of the wing.

The plane carries six passengers in the passenger cabin, which is entirely enclosed, while a seventh is carried in the pilot's cockpit in front of the cabin. The power plant consists of a 185-horse-power engine driving a tractor screw. At present the maximum speed is about 90 miles per hour, while the cruising speed is about 75 miles per hour. The tank capacity is such as to give the machine an endurance of ten hours at cruising speed, with which amount of fuel there will still be sufficient disposable lift to carry pilot and four passengers. In a recent flight from Amsterdam to London this machine traversed the distance in three hours and consumed less than 30 gallons of fuel. This is an economical performance and speaks well for the commercial possibilities of Fokker's peacetime carrier.

**Fokker's latest creation—a six-passenger-and-pilot monoplane for use between Amsterdam and London**

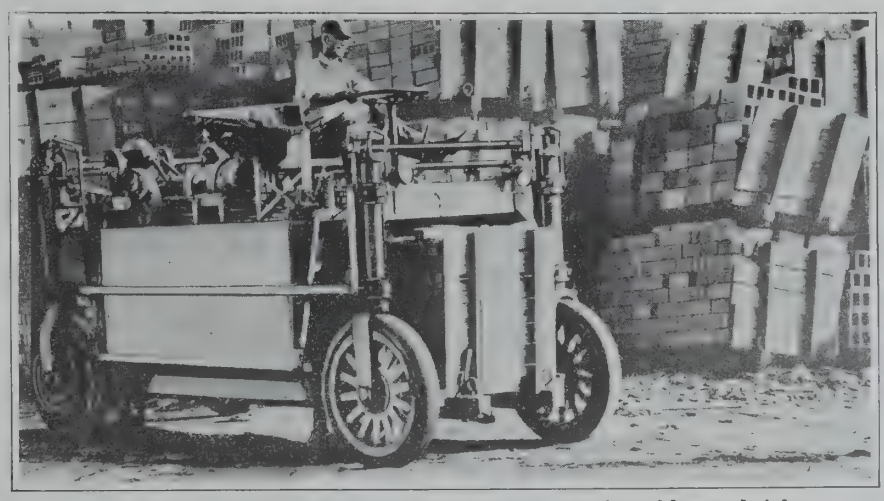
## A New Thought on the Handling of Bricks

AT last we have with us a machine that bids fair to cut building costs. It will save the work of many men and effect big savings in materials that have heretofore been wasted. This carrier was originally designed to cut handling costs in the lumber industry. As such it proved a big success. Such machines are driven by one man sitting on top, from which position he controls all movements. In the lumber yard or mill, the carrier runs over a load of big timber, placed on blotters, picks up the load automatically in a few seconds, and is off again at a ten-mile-an-hour gait to any part of the yard. On reaching its goal it drops its load just as quickly.

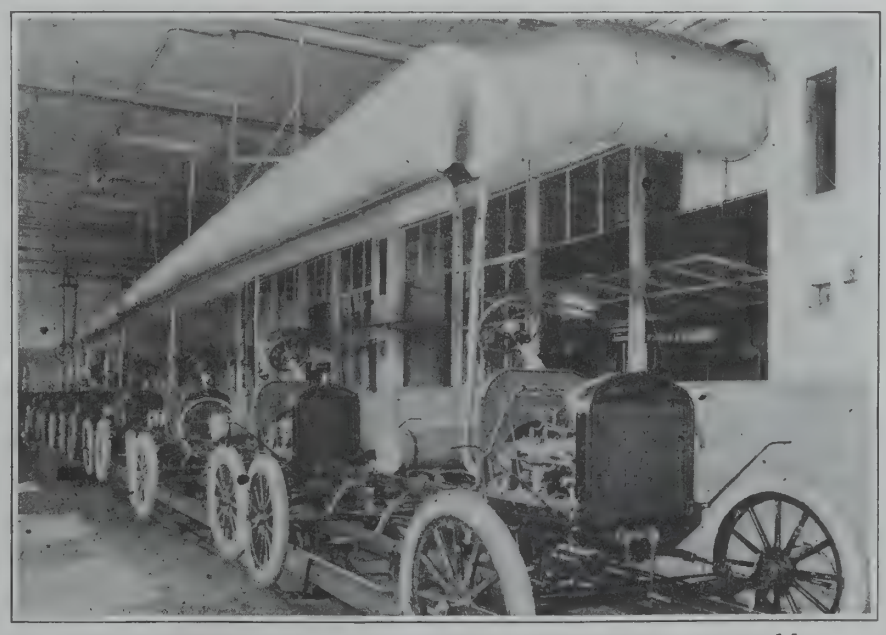
Recently four of these carriers were placed in service by a southern brick company for a most unusual way of handling brick. As such they have proved a marked success. Each of these machines loads itself and carries and discharges automatically 2,000 bricks or nearly 5½ tons to the load, without breaking a single brick, and with a competent operator will pick up or discharge a load in less than eleven seconds.

The brick is located about thirty-five miles across Lake Pontchartrain from New Orleans. These bricks or tiles are placed in crates, 1,000 to a crate at the kiln or plant, after which they are picked up by the carrier which straddles two of these crates and brings them down to the wharf where they are loaded in barges by means of steam cranes. They are removed in the same manner at the brick wharf in New Orleans.

From the wharf they are again picked up by the carriers and deliveries are made by them direct to the buildings under construction without removing the bricks from the crates or rehandling in any way. Aside from the labor-saving feature and faster deliveries, contractors prefer to have the bricks delivered by these carriers as the loads are placed in neat piles at the building and do not take up so much street room. Another very important feature is that the loss sustained through breakage in having trucks dump the bricks in the street has been practically eliminated. In many instances these crates are hoisted to the floors on which bricklayers are working, instead of by the familiar hod-carrier method. As each crate contains a thousand brick, one can readily picture the convenience and savings which this new method of handling accomplishes in the brick and building industries.



**Lumber-carrying truck doing service as a carrier of heavy brick**



**The carbon monoxide fumes from these automobiles are removed by the suction system overhead**

## Artificial Wool from Cotton Waste

ANNOUNCEMENT has been made that a process has been discovered by which artificial wool can be produced from cotton waste. The basis of the artificial wool is cellulose acetate, and the material is claimed to be an even better insulator against heat and cold than ordinary wool to wear equally well, and to take with equal success a dye of any desired color.

The new material has, it is understood, been subjected to severe tests by the textile department of the Leeds (England) University, where it has been successfully converted into fabrics. Cloth was woven with a mixture consisting half of artificial wool and half of natural wool, the product resembling tweed. The cloth, according to Prof. A. F. Barker, head of the department concerned, would prove serviceable for men's wear or for wear by women who fancy cloth resembling homespun.

Prof. Barker declares that artificial wool will have results corresponding to those of artificial silk, but pure wool will not be ousted from the market any more than pure silk has been. It cannot be assumed that people will prefer fabrics of artificial wool to those of natural wool. The artificial wool, however, should be much cheaper than natural wool, and it may be found to have wearing qualities which will commend it to the workers. The *Overseas Daily Mail* states that it is recognized that the new product has certain limitations, one of which is its liability to break and its inelasticity. Owing to this it may not at present be possible satisfactorily to use it in the production of yarns on the worsted principle, for which purpose it is necessary for yarn to possess a uniforming combing length of 2 inches or more. Where short fibers can be employed, however, such as in woolen yarn and cloth manufacture, it may prove serviceable.

## Keeping the Automobile Exhaust Under Control

THE dangers arising from inhaling carbon monoxide gas, even in greatly diluted form, have been pointed out so often and so strongly of late that they are a matter of common knowledge. It is well known that an automobile, operating in a closed garage, generates dangerous fumes which are apt to prove fatal to those working in such close confinement.

With these facts so well established, we can turn to the accompanying view with a greater sense of appreciation for what one of our leading automobile manufacturers has done. Here is the final assembly line where the automobiles are given an engine test. To protect the health of the workers, specially-constructed pipes are attached to the motors and rise to join the suction system above in the manner of trolley poles. The pipes connect with the suction system by means of soft rubber strips which form a flexible channel, as shown. In this manner a satisfactory connection is effected.

# Items In Brief

*A Department Devoted to Current News in All Fields of Pure and Applied Science*

## *Power and Fuels*

**Natural-Gas Gasoline.**—The natural-gas gasoline industry has made large contributions to the supply of motor fuel and has achieved remarkable advances since its beginning. In increasing the supply of motor fuel natural-gas gasoline is a direct means of conservation in that its extraction does not destroy the gas in which it is contained. Experiment has demonstrated that the extraction of gasoline from natural gas does not reduce appreciably the value of the gas for heat, power, and light, but that it is a benefit, for it removes not only the water but also the gasoline, which causes leakage by disintegrating the rubber gaskets in the pipes. Statistics covering the eight years from 1911 to 1918, inclusive, show that an estimated volume of 1,145,113,000 cubic feet of natural gas was treated during that time in the manufacture of gasoline and that the total quantity of gasoline obtained was approximately 755,497,000 gallons. After finishing this supply of gasoline, the natural gas treated was sent through transmission lines to distributing companies or direct to the consumers and utilized for fuel and light. The industry may therefore be compared favorably with the carbon-black industry, in which the natural gas is destroyed.

**Chinese Coal.**—According to A. M. G. Grant, a consulting mining engineer who recently returned to Great Britain, 100,000 tons of coal have been shipped as an experiment from China to Newcastle-on-Tyne. It is said that the coal is "of excellent quality, and, imported in larger quanties, could be sold at cheaper rates than British." All of which is certainly strange!

**The Fallacy of the Smokeless Chimney.**—Year after year we have been taught to consider the smokeless chimney as a symbol of furnace economy. Yet along comes J. T. Beard in a recent issue of *Power*, with the bald announcement that in a coal-burning plant a stack that is smokeless all day indicates excess of air supply. The author points out that the loss due to unburned combustible in smoked chimneys is probably not more than 1 or 2 per cent of the heat in coal and this is more than balanced by the loss due to excess air in the smokeless chimneys. The real objections to smoke are: First, the sooting of heating surfaces, and this trouble can be taken care of with soot blowers; second, interference with the health and comfort of the community. Mr. Beard concludes that in a well-designed plant it is possible to have a smokeless stack as well as economical plant by providing proper combustion space and correct furnace design.

**Something New in Steam Generators,** known as the Blomquist steam generator, is described in a recent issue of *Electrical World*, in the form of an abstract from the German technical press. The generator in question is a boiler, or high-speed steam generator, of a radically new type, which has been put in operation in a Gothenburg mill. The boiler consists of 11 pressed steel cylinders of 12-inch diameter and 8 feet heated length, which are rotated at the rate of 375 r.p.m. Due to the centrifugal action the water will cover the entire inner surface of the tubes, keeping the temperature of the steel below 300 deg. C. The tubes are supported in ball bearings, feed water being injected at one end and steam taken out at the other, through steam-tight boxes. The generator produces 13,000 lbs. of steam per hour at 50 atmospheres or 740 lbs. per square inch. This steam generator may be used to increase the pressure in existing plants, where high-pressure turbines can be employed to utilize the increase in boiler capacity thereby obtained.

## *Automotive Progress*

**Britain's Motor Signals.**—It is reported that it will "shortly be made compulsory" for uniform road signals to be used by drivers of all vehicles in Great Britain. "The signals are to be made by either the arm in the case of right-hand-drive cars, or by a mechanical arm in the case of left-hand-drive vehicles," and, as a commencement, they will comprise: Raised arm, "Stop." Horizontal arm, "Turn to the right." These signals must be given from the right-hand side of the car. In London additional signals will be brought into use. It is added that the use of the left-hand-drive car may be affected. "Although the actual type of mechanical signal necessary in this case has not yet been selected, it will probably be found more convenient to use cars fitted with the right-hand-drive than to install a device which cannot for some time be reliable." In interpreting all this, we must of course remember that Britain keeps to the left.

**Automobile Bodies by Electro-plating.**—In a recent issue of the *Automobile Engineer* there is described a novel process for making metal panels for automobile bodies. The process is an electrolytic one, in which a mold is provided of the desired profile and is rendered electrically conductive; also a member which operates with it in such a manner that when placed together they form the walls of a vat, and constitute the anode and cathode members. When electric deposition is completed, the finished article is removed from the pattern, and the operation can again be repeated upon the latter. One wall of the vat is made of the metal which it is required to deposit, and it is insulated from the cathode member. Special means are provided to secure an even deposition of the metal; the vat is sealed and an upper tank is provided to contain the electrolyte, a constant vigorous stream being maintained.

**Our Motor Fuel Situation.**—The number of automobiles in service increased about 1,700 per cent from 1909 to 1918, while the production of gasoline increased 560 per cent, and the production of crude oil only 95 per cent, according to the Bureau of Mines. Because of the great demand for kerosene, it is unlikely that the quantity of gasoline can be increased by making it less volatile than now. The extraction of gasoline from natural gas is approaching its maximum. The supply of fuel oil from which gasoline may be obtained by cracking is sufficiently large, although the demand for fuel oil has increased rapidly and the price has more than doubled, but the process of cracking is expensive and would be unprofitable without a further increase in the price of gasoline. The use of alcohol as a motor fuel will probably increase, as well as the use of benzene produced from coal tar.

## *Pure Science*

**The International Congress of Mathematicians,** which recently met in Strassburg, decided to hold the next congress in New York in 1924.

**A Remarkable Coal Mining Laboratory** has been installed under the science and engineering building of the Carnegie Institute of Technology at Pittsburgh. The laboratory comprises a full-size coal mine, a mine locomotive and a complete set of coal and metal mine machinery, furnished by various manufacturers.

**Agricultural Experiment Stations in Alaska.**—The U. S. Department of Agriculture maintains five agricultural experiment stations in Alaska; viz., at Sitka, Kodiak, Matanuska, Fairbanks and Rampart. The last named is just under the Arctic Circle, where the temperatures range from 88 above to 63 below zero Fahrenheit. These stations, says an announcement from the department, have done considerable work in breeding and establishing new varieties of grains, berries, fruits and other economic plants suited to the short season of growth, and have also promoted the raising of domestic animals, of which there is great need in Alaska on account of its remoteness from the rest of the world. At present the largest farming settlement is in the vicinity of Fairbanks, in the Tanana Valley, raising 5,000 bushels of grain in 1919.

**The Death of Dr. Margules.**—Mr. Fitzhugh Talman's appeal in behalf of the Austrian meteorologists, recently published in our correspondence column, is reinforced by the statement that has appeared in the London *Times* that Dr. Max Margules, well known for his brilliant contributions to dynamic meteorology, died of starvation in Vienna on October 4. A warm tribute is paid to Margules in a current number of *Nature* by Dr. Ernest Gold, of the British Meteorological Office. Margules published in 1892 and 1893 a series of masterly papers on the motion of air on a rotating spheroid, and in 1903 he published a remarkable memoir on the energy of storms. In recent years he had retired entirely from meteorological work and up to the time of his death had been striving to live on a pension of 400 crowns a month, which is equivalent to less than two dollars. The American Meteorological Society is raising a fund in behalf of the meteorologists of Austria and their families, and has already begun to remit food drafts. Contributions can be sent to the secretary of the society, Dr. C. F. Brooks, U. S. Weather Bureau, Washington, D. C.

## *Transportation*

**How Railroads Handle Coal.**—The Norfolk & Western Railway Company has contracted for another car dumper which will have a tremendous capacity. This machine will take the largest road cars and overturn them into specially designed motor-driven transfer cars having power-operated bottom gates through which the coal will be distributed to the lines of coal-loading bins on the piers. The vessels coming alongside the piers will then be loaded rapidly by gravity with breakage of the coal reduced to the minimum. Mechanical trimmers, which effect a wonderful saving by eliminating hand trimming, will be used. Could the road cars be supplied without interruption, this machine alone would have a capacity for loading into boats over 8,000,000 tons of coal per year when operated for eight hours during each working day. This represents 1,440 ocean-going vessel cargoes.

**Fuel Oil for Locomotives.**—At the annual meeting of the International Railway Fuel Association at Chicago, some interesting figures were presented relating to comparisons made on the Santa Fé system where one-half of the locomotives have been constructed or converted to burn oil. The fact was brought out that the life of a boiler fired with coal is about 10 per cent greater than one fired with oil, while the life of the tubes is about 40 per cent higher in the coal burners.

**Railway Fuel Conservation.**—According to the *Railway Age*, the conclusions reached regarding fuel conservation are that this conservation depends upon efficient education of the whole of the railroad staff rather than confining it to the train crew, and the provision of a constant stimulus to maintain their intensity of interest in the subject by friendly competition and public spirit. Some other phases of the subject, such as economical speeds, facilities for adequate train housing and repair, selection of the best types of locomotives for specific roads, and train despatchers' duties are referred to, all of which are stated to be contributory factors in fuel conservation.

**Chinese Railway Standardization.**—Although it would probably be economically impracticable for one nationality to furnish and equip China with the extensive railway mileage necessary for the development of the country, it has been pointed out that the advisability of maintaining an adequate staff of American technical experts on the Chinese Railway Standardization Commission, as well as the expediency of offering facilities for the training of Chinese engineers in this country, are evident in the light of the opportunities for renewals and extensions of equipment by American manufacturers accruing from the establishment of American standards on the Chinese railways.

**A New Oriental Line.**—The steamer "M. S. Dollar" sailed from Vancouver on October 22 for the Orient, inaugurating on this voyage a new line of Oriental commerce. She has been fitted up with refrigeration machinery and has a capacity for 300 tons of frozen produce. This space will be used to ship Chinese fresh game, eggs, and meats to New York by direct steamer. If the venture proves successful other vessels of the Canadian Robert Dollar company will be fitted up with refrigeration holds. The ship will carry butter and other American dairy products westward. She operates on the triangular New York-Vancouver-Orient service.

## *Communication*

**South African Radio.**—The Union Government has acquired the station at Windhuk, which was erected by the Germans and which originally was powerful enough to communicate with Berlin. This station will be put in order in the near future and will be one of the best equipped stations in the world. The

Windhuk station will be working with Oxford *via* Nairobi and Cairo, the scheme providing for stages of 2,000 miles each, transmission over which distance is assured. This will no doubt greatly relieve the ocean cables between South Africa and England, which are now unable to cope effectively with existing traffic.

**Improvements in Arc Generators** are described in a recent issue of *Wireless Age*, especially as concerns the Poulsen type. For purposes of coil insulation it has previously been considered essential to place the magnet windings in the lead from the generator to the arc electrode which is grounded, and with this arrangement it is inadvisable to ground the frame of the direct-current generator on account of the danger of burning out the generator insulation. L. F. Fuller, who has made many improvements on the Poulsen arc, finds that by combining the choke and magnet coils and placing them in the lead connected to the antenna side of the arc, and by grounding the generator side of the arc to the generator frame, a better and cheaper construction is possible, and the generator is safer to handle. Usually, but not necessarily, the negative lead is connected to the grounded side of the arc.

**Fading of Radio Signals.**—A detailed study of actual cases of "fading" or fluctuation in the strength of signals occurring in the area of the Persian Gulf and the Red Sea is given with the aid of maps and sections of intervening mountain ranges in a recent issue of the *Wireless World*. From the results of his observations the author expresses the opinion that these effects are entirely due to the differences in altitude of the intervening country, and he puts forward the theory that the intercepted wave does not pass to a considerable height (probably not more than one or two miles) above sea level, but that the maximum height attained increases with the distance, so that the less the range the nearer the semi-parabola of its course approaches to a circular arc.

**A Worthwhile Tube Transmitter.**—In a recent issue of *Telefunken-Zeitung* there appears a description of a ten-kilowatt transmitter employed at the Nauen station, using a battery of 30 tubes of 500-volt rating. The method of connection is described, and the method of operating. It is stated that this installation gave much trouble at first, but that the difficulties, mainly connected with the generation of oscillations of very high frequency, were gradually overcome. There is reason to expect that it will be possible to construct 10-kilowatt tubes and connect them in parallel so as to attain outputs of 500 to 1,000 kilowatts.

## *Electricity*

**Oil Switches for Heavy Currents** are generally accompanied by difficulties in dealing with large outputs. The electrodynamic effects which arise with very heavy currents are the most serious source of danger. The very heavy current-rushes exercise both thermic and dynamic effects on the whole installation, and are most difficult to control by any preventive method, short of the predetermined artificial limitation of the short-circuit current. The value of this should not exceed 50,000 effective amperes. An authority states that if this limit is not exceeded, the process of opening a switch is more serious than that of closing it.

**Safety Panels in Sections** for residences, apartment houses, office and public buildings are now coming into general use. Metal sectional covers enclose the switches and bus bars, the switch buttons and plug fuses alone being exposed. This gives full protection to the operator against contact with live parts. Should it be necessary to replace a damaged switch, the sectional cover can be removed and repair made without disconnecting the wires, exposing other switches, or removing the panel from the box. The ensemble is a strong, compact panel of excellent workmanship and attractive appearance.

**Foot-Operated Switch for Foiling Holdups.**—The crime wave which has swept through many of our leading American cities of late has inspired John C. Rundback, a jeweler of New York City, to invent a novel form of foot-operated switch. This device consists of contact-making units arranged in the form of a long strip, and installed along the bottom of a counter or desk. In the event of a holdup, the victim can press any part of the contact-making member with his foot, thus closing a circuit and operating any given apparatus. The circuit may be used to ring a bell outside the store, turn in an alarm to the nearest police station, drop a steel curtain between the victim and the thieves, or for any other purpose. The contact-making member may even be arranged along the edge of the counter or along a wall, so that it may be depressed by leaning against it. At any rate, this novel switch arrangement may be operated while obeying the command of "hands up" and without arousing the suspicion of the bandits.

**Locating Buried Conductors.**—A long-buried conductor, for instance a cable or a pipe line, will tend to direct and concentrate electromagnetic waves traveling over the ground where the conductor lies buried, according to *Electrical World*. This is utilized for determining the location of such conductors in a method patented by a German radio company. A big coil antenna excited from an ordinary spark station on a motor car serves as a transmitter, and a similar coil antenna is used for receiving. The two antenna frames are carried along the ground, and the man receiving the message has to direct the carriers till a maximum sound is heard in his headphones. A wave length of 1,500 meters is employed, and using a 200-watt transmitter, the antenna frames must be kept 40 or 50 feet apart to avoid direct induction. Even a thin lead-covered single-pair telephone cable 5 feet or 6 feet deep could be located within a few feet by means of this outfit.

## *Mechanics*

**Getting Along Without Hand Filing.**—A German company has introduced a milling tool which produces a finished surface equal to the best obtainable with hand filing. The cutting edges of this machine are similar to those of a file, but arranged spirally so that it is only necessary to press the work against the revolving cutter in order to get a true surface. The machine will cut through the mill scale of rolled sections and polish them bright in a remarkably short time. It will similarly cut through a crust of castings and give a bright smooth surface. It is conceded that a mechanic with a new file can cut one-fifth oz. of filings from a rough casting in a quarter of an hour, while the new machine will cut better than 17½ oz. in the same time from the same casting. What is more, the cutting member of the machine is said not to clog, and can therefore be used for a number of metals such as lead, copper, tin and zinc, as well as for such materials as hard rubber, slate, marble, celluloid, hard wood, bone and so on, where a file would be more or less useless.

**A High Speed Hack Saw** suitable for manufacturers having quantities of bar stock to be cut to repetition size, and offering a considerable saving in time and labor, has been brought out by a Chicago machine builder. At maximum speed and feed, the new machine will cut six-inch round cold-rolled steel in ten minutes, the resetting of the stock bar after each completed cut being automatic. Bars up to 20 feet in length may be handled and pieces up to 3 feet in length can be cut off.

**How Precision Blocks are Made.**—The general requirements of gage blocks, according to *Machinery*, are: (1) The two gaging surfaces should be true planes; (2) the gaging surfaces should be parallel to each other; (3) the length of the gage should conform to required dimensions and (4) the gage blocks of a set should differ in size by increments, making it possible to obtain any dimension within the range. A special chromium steel is recommended as a suitable material. The steel bars are sawn, straightened and ground, and after being drilled and countersunk are heat treated, again ground and finally sand-blasted.

## *Engineering*

**Canal Project for France.**—Plans are being formulated for the construction of a canal to extend from the port of Dunkirk to the basin of Saarbrücken, permitting the navigation of boats up to 600 tons. The length of this canal will be approximately 600 kilometers (372 miles). The canal will be known as "Le Canal du Nord-Est."

**Poland's Longest Pipe Line.**—The longest pipe line in Poland for the transmission of oil was opened on September 6, 1920. This duct, which runs from Jaslo to Gorlitz, is constructed of 10-inch piping and is 28 kilometers (17.38 miles) in length. It is connected with another line that runs from Jaslo to Mezinek. Both these lines were constructed by the Polish Government and are used for the transmission of oil from the wells in Mezinek to numerous refineries and factories. Since the construction of the new pipe line a sufficient number of factories have begun to use oil as fuel instead of coal to result in the saving of 6,000 carloads of coal per year.

**Why Rails Rupture — and a Cure.** — From the *Comptes Rendus* we learn that a most frequent cause of the rupture of rails free from local manufacturing defects consists in the gradual development of fine fissures on the surface subjected to rolling action. Periodic examination and withdrawal of service rails showing signs of fissuring is the only preventive measure suggested up to the present time. The authors of the article show that the phenomenon is a very general one in materials subjected to intensive superficial work-hardening, and is particularly marked in hard metals such as chilled cast iron and hardened tool-steels. These French authorities suggest that superficial annealing prior to the critical age will rejuvenate rails and prevent the occurrence of fissuring. Such an operation could be carried out readily by means of the equipment mounted on wheels which has been devised for superficial hardening of the rolling surface. Such thermal cures, it is held, would do much to prevent fissuring and prolong the life of rails.

**Concrete Pouring on a Vast Scale.**—We are accustomed to big figures when speaking of modern concrete work. Yet a recent description of a large concrete plant, which appeared in a recent issue of *Engineering News-Record*, is startling enough to bear quoting here. The plant is to distribute 30,000 cubic yards of concrete from two 175-foot towers over an area of 800 feet by 1,800 feet. The elevator of each tower holds one cubic yard and does 30 trips an hour. The greatest length of main chute is 350 feet. Chutes are 12 inches wide and 8 inches deep at a uniform slope of one in three. A novel feature is that the chutes are practically rigid, being supported at 50-foot intervals by timber towers and braced laterally by truss wires over horizontal struts.

**A Forty-Five Mile Aerial Cable Tramway** being constructed in Colombia, South America, is reported to be half completed at this writing. It starts at Mariquita, at an elevation of 1,500 feet, crosses a 12,000-foot summit and descends to Manizales, which is at an elevation of 6,700 feet. The cableway is supported on 437 steel towers, of which 8 are over 130 feet high. The longest span is 3,168 feet. The track cable is a 2⅝-inch wire rope running on 24-inch sheaves. The carriers take normal loads of 670 pounds, traveling at 400 feet per minute. Steam driving plants will be employed as motive power, arranged in 30-horsepower units and distributed among 20 stations. Twenty-one miles of this cable tramway has been in operation since 1916.

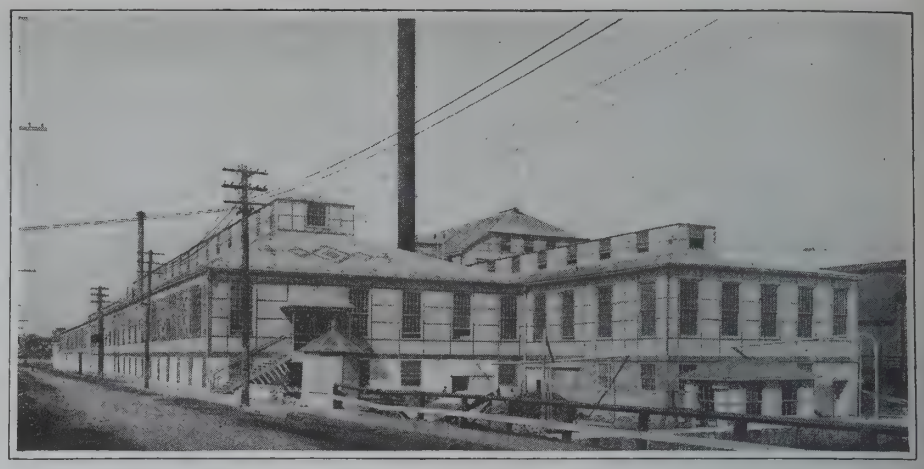
## *Industrial Efficiency*

**American Import Figures.**—The Bureau of Foreign and Domestic Commerce has just published part 1 of "Trade of the United States with the World, 1918-1919." This bulletin gives statistics covering the imports of merchandise into this country, by countries of origin and principal articles, during the calendar years mentioned in the title. For most of the articles included in the table, quantities (in addition to values) are given in the customary commercial units or in weight. This new publication, which is expected to prove peculiarly useful to American importers and merchants, is part 1 of Miscellaneous Series No. 106, and may be obtained for 10 cents from any of the district or coöperative offices of the bureau or from the Superintendent of Documents, Government Printing Office, Washington, D. C.

**Leather from Rabbit Skins.**—According to American Consul Norton of Sydney, Australia, a secret process, said to be unknown hitherto to the tannery trade, has been discovered by an Australian for making leather from rabbit skins and recovering the fur as a by-product in felt making. A company has been formed in Sydney to turn this discovery to practical use, having established works capable of handling about 100,000 skins a week. The leather has already been utilized in Sydney in the manufacture of boot and shoe uppers, hand bags, gloves, and other articles.

**Remitting Customs Duties to Develop Mines.**—The Vancouver Board of Trade is endeavoring to assist development of the mineral resources of the province in a manner that should prove very satisfactory to United States manufacturers of mining machinery. The mining bureau of the board has recommended that the organization approach the Dominion Government asking that customs duties on mining machinery imported from the United States to the mines of British Columbia be remitted. Though British Columbia metal manufacturers are not wholly in sympathy with this proposition they have expressed themselves as willing to assist the board in the effort if it is modified to such an extent that it will not work an actual unfairness to them.

House externally protected from fire and weather by the liberal use of asbestos shingles



Asbestos shingles cover the roof and asbestos building lumber cloaks the sides of every building in this plant

# Asbestos in Architecture

## The Growing Importance Played by This Fibrous Substance in Modern Building

By Robert G. Skerrett

WHY asbestos is what it is the man of science cannot tell. He cloaks his ignorance by calling it a fibrous, hydrated silicate of magnesia, and then, looking wise, expects you to be satisfied. Despite the fact that Nature has kept her secret well, still day by day, comes a growing realization that "mineral flax" is serving increasingly useful purposes. Here in the United States the demand and the fields of application are widening at an impressive rate, and presently even the layman will ask, "How could we get along without the stuff?"

Back in the dim days of this planet's formative period, eons and eons before human kind conceived even elemental notions of economy and safety first, asbestos was stored in the veins of the earth's rocky crust to await the time when man's proper fear of fire and a keen desire for saving in a number of directions should make him cast about for a raw substance which might serve these ends either directly or indirectly. And now asbestos is robbing the flame of much of its menace, and the same material is conserving both heat and cold which primarily owe their intensity to the consumption of coal. Probably nothing is more suggestive of these efforts to arrest the fleeting dollars than the way in which asbestos products are figuring in modern architecture.

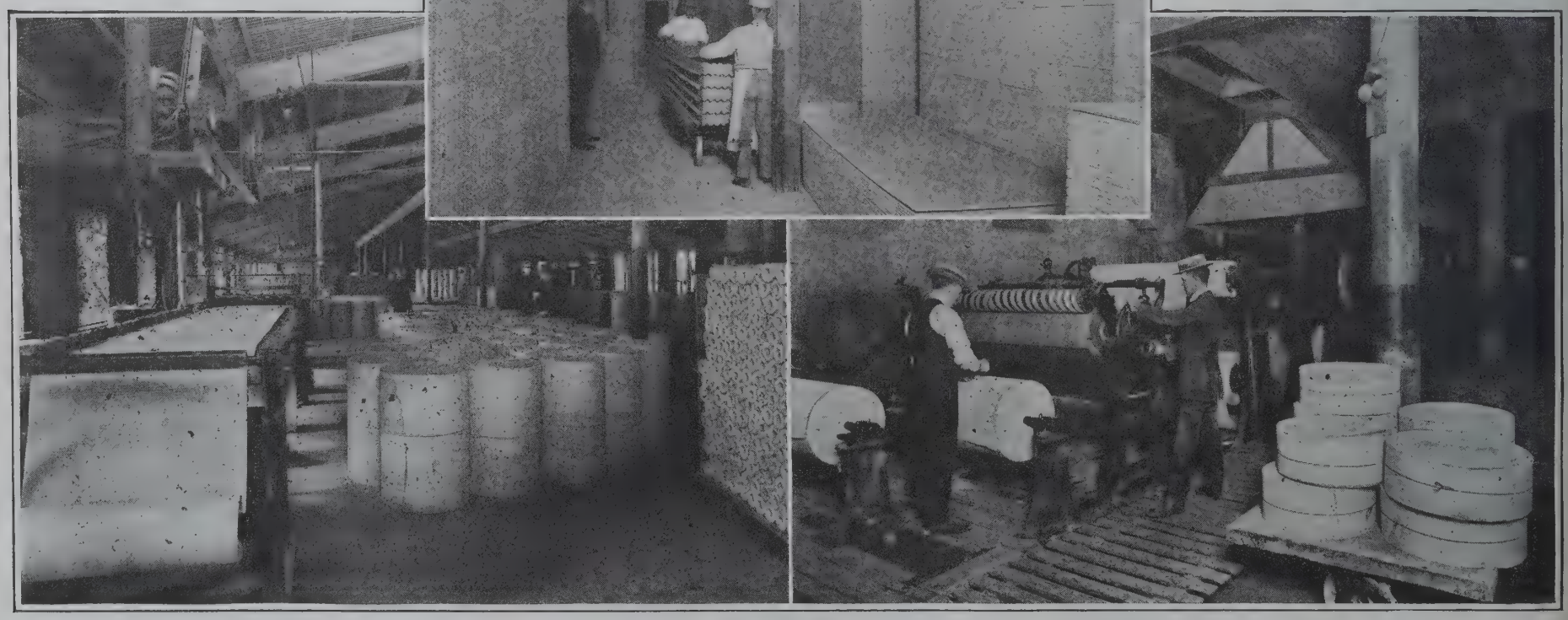
Here in the United States the annual fire loss totals more than $250,000,000, and the startling fact about this wastage is that most of it is a needless sacrifice. Because of this tribute to the flame insurance rates rise proportionately, and for our heedlessness we trace the "wicked circle" of added outlays. The wooden shingle is so often tinder to the chance spark; and the frame building and timber structures generally can offer but a feeble resistance to fire. Aside from this inherent fault, woodwork exposed to the weather is more or less perishable, especially if not painted or otherwise subjected to a preservative treatment.

But structural metal in the cases of roofing and various forms of sheathing is all too frequently no more enduring than wooden shingles, clapboard, and the like. Heat and cold, moisture, oxygen, and atmospheric impurities attack the iron, steel, copper and tin and bring about their oxidation and disintegration. Paint and other surfacings may suffice if applied at short intervals, but they involve repeated expenditures that represent a heavy offset against any apparent initial savings. Splendidly as wood and metal supply our wants in some directions it is dawning upon us gradually that we need more enduring and fireproof materials for certain parts of our industrial structures, our homes, our office buildings, our schools, etc. Happily for us asbestos is at hand to help out.

Inventive genius and manufacturing cunning have made possible shingles, roofing, siding and "lumber" composed of asbestos or of asbestos and hydraulic cement, according to the service required. The public is pretty familiar with asbestos covering for pipes, but it is only comparatively recently that we have profited by European example and accepted the asbestos shingle as something to be desired. It was only natural, with the ice thus broken, that our business enterprise would soon find other ways in which to work up asbestos and to employ these products to advantage. The pioneer in this evolution was Ludwig Hatschek, an Austrian asbestos worker, who, bent upon making thin sheets or slabs of cement for building purposes, conceived the idea of using asbestos fiber as a reinforcing material. Because of his invention, a single plant in Austria turns out yearly more than 100,000,000 square feet of asbestos-and-concrete roofing in forms susceptible of easy application. The secret of success depends upon the manner in which the asbestos and the cement are combined.

It seems that where the Hatschek process is not followed that the mixing of the material dry and then adding

(*Continued on page 583*)



*Left:* Corrugated paper from which "air-cell" coverings for pipes, etc., are made. *Right:* The final steps in the manufacture of asbestos paper or felt. *Above:* A stock-room display of corrugated roofing and siding of asbestos

**Some of the forms in which asbestos contributes to the safety of modern building construction**

## The Flyer's Artificial Eye and Ear

**By Dr. Alfred Gradenwitz**

THE flyer's eye and ear are bound to fail him in a fog, in the clouds and by night—the eye, in so far as he no longer detects anything to guide him in the gray uniformity surrounding his machine, and the ear, inasmuch as his sense of direction and verticality, depending on the canals of the middle ear, no longer tells him at what angle his machine is banked.

In the last stage of the World War, all the huge fighters of the German army were fitted with a wonderfully efficient apparatus which could be fitly termed a substitute for the human eye and ear, viz., the Drexler Gyroscopic Steering Gage, which, of course, was developed on lines quite independent of the Sperry instrument. In designing this apparatus, the inventor availed himself of a less well-known gyroscope law. In fact, so far from starting from a "triple-liberty" gyroscope, that is, a top freely rotating in a Cardan suspension, he based his work on a "double-liberty" gyroscope, viz., a top free to rotate round its own axis, and, in addition, in another plane, though the latter rotation is limited by elastic strips or springs. In other words, a top in a Cardan suspension, of which the outer ring is fixed while the deflection of the ring carrying the gyroscope is limited in the manner just outlined.

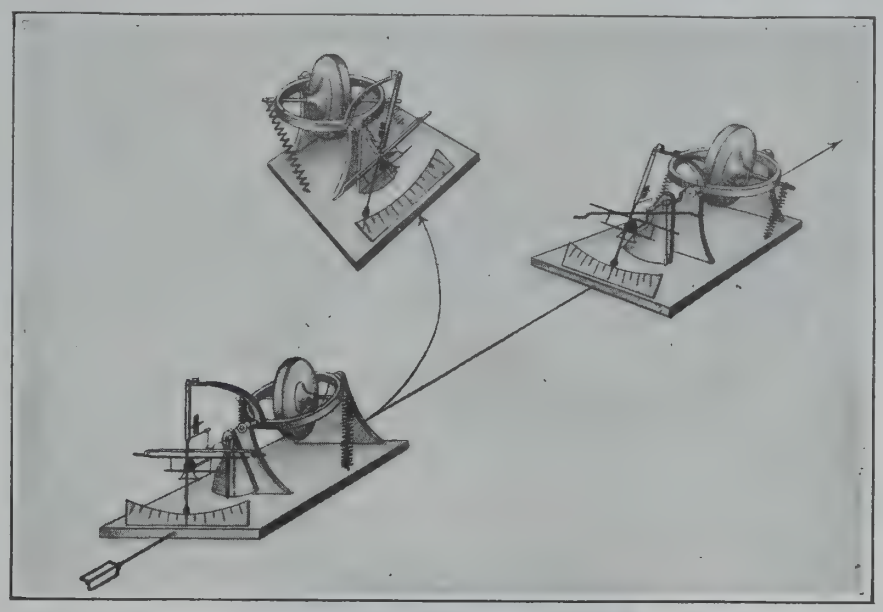
If such a gyroscope be inclined sideways it will not show any deflection, but, on account of the tension of the elastic bands or springs, and the stationary arrangement of the ring carrying the top at right angles thereto, it will readily follow any inclination of the gyroscope.

If, however, the apparatus be turned round in the direction of the arrow, the *law of precession* will come into play; that is to say, the top will respond to any thrust in the direction of the arrow by a rotation at right angles thereto. So far from following the rotation corresponding to its previous position, the top will therefore deflect, overcoming the tension of the elastic bands as indicated pictorially.

A "double-liberty" gyroscope such as this, provided with an index, is so installed on the flying machine that the top, as long as no outside forces are exerted upon it, will rotate in a plane determined by the vertical line and the direction of flight. This top, apart from its rotation round its axis, can only perform a motion limited by springs at right angles to the longitudinal axis of the flying machine. Where the top occupies the position just outlined, the index connected with it will be in its central position, thus showing that the machine is flying straight ahead. If, however, the machine voluntarily or involuntarily describes a curve, the outside frame carrying the top, which is rigidly fitted into the flying machine, will be turned, thus causing the top and the index connected with it to deflect at right angles thereto, to the right or left, according as the curve described is a right-hand or a left-hand curve. As soon as the machine is again flying in a straight line, the springs above referred to will reduce the curve index to its central position.

The gyroscope is combined with a transversal pendulum oscillating in a damping glycerine casing, for indicating any transversal deflection from the horizontal position of the carrying planes, while a specially designed liquid level gage allows even the slightest longitudinal inclination of the plane to be noted. The reading marks of the pendulum should always agree with the upper carrying surfaces of the flying machine phantom, if the machine, in flying either in a straight line or in a curve, is to be in equilibrium. A special readjusting attachment enables the apparatus to be adapted to the peculiarities of the machine or any personal preference of the pilot by allowing the angle of inclination in curves to be increased or reduced at the free will of the aviator.

The use of this steering gage not only means increased safety to the pilot and passengers, but relieves the enormous strain upon the nerves of the pilot, who no longer has to spy about and anxiously to look for his bearings at the ground below him through the fog, clouds and darkness.



**The German double-liberty gyroscope, showing the manner in which deflection of the plane carrying it from the true horizontal affects the instrument**

## Finding a Cool Hat

HOWEVER lightly one may be clad there is little comfort in the hot weather if the hat is not having a cooling effect. In this connection some interesting tests have been made to determine the heating or cooling action of various kinds of hats commonly worn. On a very bright day when the shade temperature was 96.8°F. seven individuals were given hats, each one being of a different type. These were worn outdoors for two hours and at the end of this time the temperature inside the hats was taken.

In the case of a typical soldier's hat, made of cloth and with a hard peak, the reading was very high, being no less than 98.6°F. In an ordinary cloth cap it was 94.1°. Inside the hard round bowler the record was 92.3°. Contrary to expectation the silk hat came fourth on the list with a temperature of 89.6°. The hard straw hat was not very much cooler with a temperature of 86.0°. Very much more comfortable was the soft felt hat with a reading of only 79.7°. It was discovered that, where the felt was black, or very dark in color, the air inside was much hotter than in the case of a light shade. The figures given are for a hat of a somewhat pale gray hue. Coolest of all hats is the soft straw Panama, which gave a temperature of 77.9°.

**How the new system facilitates the installation of wall fixtures; and the outlet plate, ceiling plug and wall plug**

## When a Lighting Fixture is Not a Fixture

**By George Gaulois**

ELECTRIC lighting fixtures need be "fixtures" no longer. Why? Because a device recently invented and now developed on a practical scale makes it possible to move electric chandeliers and wall brackets from place to place as easily as electric toasters, vacuum cleaners and other appliances are plugged in the usual lighting circuit.

The basis of the new invention, which promises to mean much in the electrical industry, is a plug with curved blades. This plug may be attached to any wall light. With its lighting fixture attached, this plug is inserted with a rotary motion into a new type of electric outlet, the blades pointing upward. Electrical and mechanical connections are made at the same time; and the plug, supported by the curved blades, is strong enough to hold the heaviest wall fixture. The outlet looks very much like the familiar baseboard plate, having two parallel slots in a rounded triangular center.

An inconspicuous circular plate marks the new ceiling outlet, which forms a unit of this novel system of fixtures. A plug with curved prongs also is provided for this outlet. It differs from the wall plug, however, in that one-half of the plug is inserted at a time, the prongs extending in opposite directions. A hook at the other end of the plug supports the chandeliers, and makes the necessary electrical connections by means of flexible wires. Now these mechanical hooks, as distinguished from the curved prongs which make the electrical connections and also secure the lower hooks to the ceiling, may be arranged either in a coinciding or in an opposite manner, so as to form in construction either a hook or a ring. In either event the ring of the chain supporting the fixture serves to hold the two halves together, thus locking the entire arrangement in place.

The devices for this new system are to be manufactured by a number of companies and will be on the market by the beginning of the new year. The flexibility of lighting which will be afforded by this system will be especially appreciated in the home. The ability to rearrange and replace lighting equipment without the services of the electrician will make possible a rapid development in the science of home lighting. Builders of new homes will be freed from the necessity of selecting all their lighting fixtures before the house is finished. A sufficient number of outlets provided for in the architects' plans will make it possible to buy lighting fixtures as needed after the house is finished.

## What Is Dry Rot?

THE term "dry rot," the Forest Products Laboratory finds, is applied by many persons to any decay which is found in wood in a comparatively dry situation. Thus loosely used the term actually includes all decay in wood, since wood kept sufficiently wet cannot decay.

In the more limited sense in which pathologists use the term, "dry rot" applies only to the work of a certain house fungus called *Merulius lachrymans*. This fungus gains its distinction from the fact that it is frequently found growing in timbers without any apparent moisture supply; in reality it does not grow without moisture and is as powerless as any other fungus to infect thoroughly dry wood. Given moist wood in which to germinate, it is able to make its way a surprisingly long distance in dry timbers, drawing the water it needs from the moist wood through a conduit system of slender, minutely-porous strands. Wood in the typical advanced stage of dry rot is shrunken, yellow to brown in color, and filled with radial and longitudinal shrinkage cracks, roughly forming cubes. In many instances these cracks are filled with a white felty mass, the interwoven strands of the fungus.

The dry rot fungus is active in nearly every region of this country, in Canada, and in Europe. It is destructive to timbers and logs in storage. Soft woods are more commonly infected by it than hard woods.

# The Heavens in December, 1920

## Star Clusters—Their Bona Fides and Their Distances from Us

By Professor Henry Norris Russell, Ph.D.

IN various parts of the sky the stars appear to be grouped into more or less conspicuous clusters. Most of these are visible only with the telescope, but here and there we find one in which the individual stars are so bright, and so widely scattered in the sky, that the character of the group can be recognized by the naked eye. The astronomers of ancient times—who were active and careful observers, so far as the means at their disposal permitted—recognized several of these clusters, and gave them names, which have come down to us, and are still in use. The most conspicuous and the most famous cluster of all is doubtless the Pleiades, which, from the brightness of the stars and their close association, attracts the attention of the most casual observer. Not far away, and also in the constellation Taurus, is the more scattered group called the Hyades—the "rainy stars," because their appearance marked the beginning of the rainy and stormy season in Greek waters. Farther east in the heavens, in Cancer, is a hazy spot, known to the ancients as Praesepe, meaning a sheepfold or a manger. The unaided eye just fails in this case to recognize the individual stars, but a small opera glass shows them distinctly. Eastward again, beyond Leo and to the north, is a scattered group of stars, just comfortably visible to the naked eye, which has been elevated to the dignity of a constellation, Coma Berenicis, or Berenice's Hair.

### Are They As They Seem?

When the modern astronomer comes to consider these clusters, the first question he asks is, naturally, "Are the stars of these groups really near together in space and associated in some way, or do we have to deal with a mere accidental grouping of unrelated stars, some near by, some remote, and looking close together in the sky only because they happen to be almost in line with one another?" For a compact group like the Pleiades, common sense suggests, and calculation confirms, that it is incredible that so many conspicuous stars should by mere chance be crowded into so small a region, with the whole expanse of the heavens available. But for a more scattered assemblage like the Hyades, this simple test is insufficient.

The tale has long ago been told in our columns how Professor Boss, having completed his great catalog of the proper motions of the brighter stars, found that forty stars, in the Hyades and the surrounding region, were moving across the heavens in about the same direction and at almost the same rate. This noteworthy discovery put it beyond question that the Hyades, too, were a real cluster of stars which now are fairly close neighbors in space, and have been so in the past for an indefinite time. What is more, it appeared, on careful study, that the motions of these stars in the sky were not quite in parallel lines, but that they converged toward a definite point, about ten degrees east of the bright star Alpha Orionis; so that if we could watch the cluster for ages, we should see it approach this point in the heavens, and apparently shrink together as it did so. This must obviously be an effect of perspective, arising from a gradual recession of the cluster from the sun. Observations with the spectroscope showed that these stars were actually receding, and all at the same rate—another proof of physical connection. By combining what we know of the apparent rate of motion of the cluster in the sky, and the real rate in kilometers per second, Boss succeeded in calculating its distance, which came out 140 light-years.

Not all of the naked-eye stars in this part of Taurus really belong to the cluster—for example, Aldebaran, the brightest of all, is moving across the sky in quite another direction, and is probably considerably nearer to us than the cluster stars. But these outsiders can be recognized at once by the fact that their motions do not agree with that of the cluster.

A similar community of motion exists among the Pleiades, and is found also in Praesepe, and among many, though not all, the stars in Coma Berenices. It appears therefore that all these groups are real clusters. But there is no other case in which the perspective effect of convergence of the motions has so far been detected—mainly because the other clusters cover such small regions of the sky; hence we cannot apply Boss's ingenious method to determine the distance of any of the other clusters. Success has, however, recently been obtained in the case of Praesepe. Before the war, Schwarzschild, one of the ablest of German astronomers, found spectroscopically that the brighter stars in this cluster are all receding from the sun at the same rate, and noted that this rate is almost the same as in the case of the Hyades, while the proper motion of the group, though small, is directed nearly toward the point in the heavens toward which that group is moving. This suggested that the two clusters, though sixty degrees apart in the sky, were really moving in parallel lines in space, and that, in the course of millions of years, the inhabitants of the earth might see them drawing closer and closer to one another in the sky, shrinking in size and growing fainter as they went.

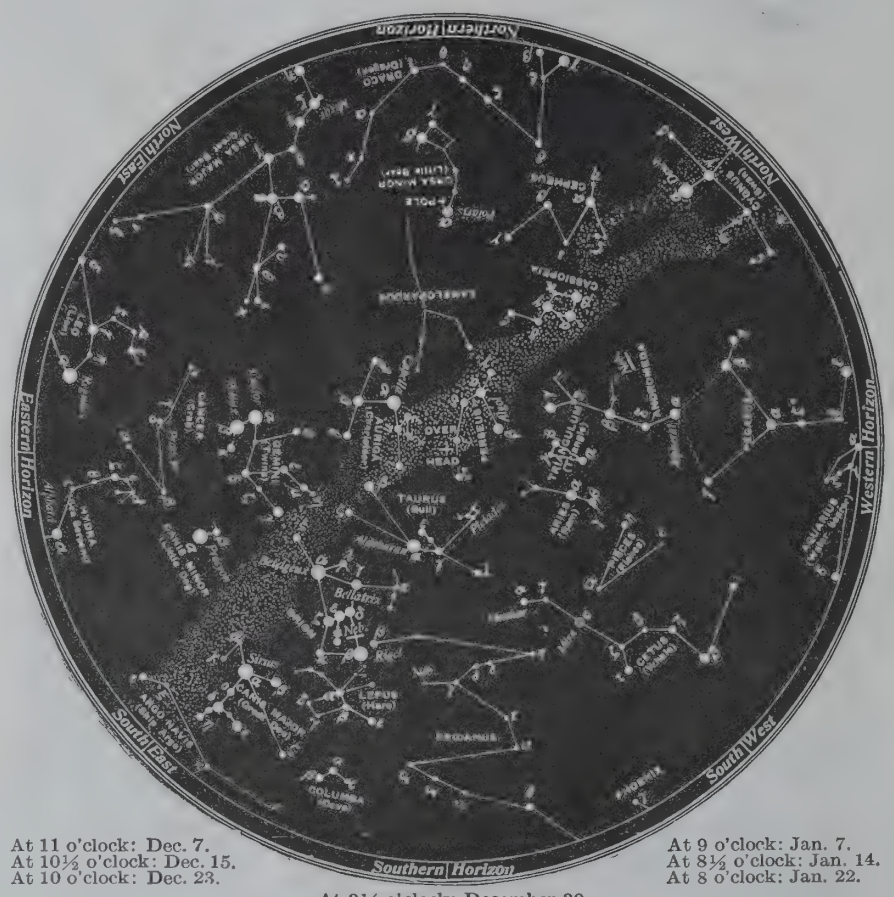
Knowing this point, it becomes possible to calculate the present distance of the Praesepe group. With the best data available, this comes out 560 light-years—four times the distance of the Hyades. A striking confirmation of this calculation has recently been furnished by another German, Kohlschütter. It has long been known that there is a remarkable relation between the brightness of the stars in the Hyades and their colors and spectral types. Stars in this cluster which are of the same real brightness as the sun are very similar to the sun in spectrum. Those fainter than the sun are redder, and more "advanced" in spectral type, while most of the brightest stars in the cluster are white, almost like Sirius in spectrum, and average almost forty times as bright as the sun. There are, however, four bright stars, clearly belonging to the Hyades, which are redder in color, and have spectra like Arcturus. These red "giants," which average some fifty times brighter than the sun, have their counterparts all over the sky, and have played a very important part in the theory of stellar evolution.

### Further Data on Distances

Kohlschütter has confirmed these facts regarding the Hyades, and made a similar study of the stars in Praesepe. In this case only the brighter stars of the cluster can be observed (the rest are too faint); but among these just the same situation is found. Most of the true members of the cluster are white, while a few, equal in average brightness to the others, are strongly reddish.

In each case the average apparent brightness of the stars is just about one-tenth of the apparent brightness of the corresponding stars in the Hyades. If we assume, as seems very probable, that the actual brightness of the stars of similar character is the same in the two clusters, we are led to a distance for Praesepe of 450 light-years—agreeing with the other as well as it is reasonable to expect, on account of the uncertainty of some of the data. The average of the two determinations, 500 light-years, is probably a very good approximation to the actual distance of Praesepe.

It may be added that the brighter stars in Coma Berenices show a similar distribution in color and spectrum, which indicates that the distance of the cluster is 300 or 400 light-years. The distance of the Pleiades, estimated in other ways, is probably about 300 light-years.




At 11 o'clock: Dec. 7.
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.

At 9 o'clock: Jan. 7.
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan. 22.

At 9½ o'clock: December 30.

**NIGHT SKY: DECEMBER AND JANUARY**

### The Heavens

Our map shows that three of the four clusters of which we spoke are now well observable. The Pleiades and Hyades are close to the meridian and very high in the sky. Practically all the stars near Aldebaran except Aldebaran itself belong to the latter group. Praesepe is well up in the east, below Castor and Pollux. The stars Gamma and Delta Cancri, which are close to it on each side, were called by the ancients the "Aselli," the donkeys which are browsing at the manger. Coma Berenices has not yet risen.

The southeastern sky is very fine, with Orion, Canis Major, Canis Minor and Gemini. With the splendid stars Sirius, Rigel, Betelguese, Procyon, Castor and Pollux in their number, and Aldebaran, Capella and Regulus among their close neighbors, it is with ample justification that these are often referred to as the "brilliant winter constellations." Leo and Hydra are rising, in the east, and Ursa Major is coming up in the northeast. Draco and Ursa Minor are low in the north, while Cassiopeia and Cepheus are well up in the northwest. Auriga and Perseus are overhead, and Andromeda and Pegasus conspicuous in the west. Cetus and Eridanus occupy the dull southwestern sky.

### The Planets

Mercury is a morning star, and is best seen about the time of his greatest elongation on the 3rd, when he rises about 5:30 A. M. Venus is an evening star, and sets about 7:30 P. M. in the middle of the month. Mars too is an evening star, and sets more than an hour after Venus when the month begins. Venus is moving eastward faster than he is, and by the end of the month the two planets are only about four degrees apart.

Jupiter is in quadrature, west of the sun, on the 10th, and crosses the meridian at 6 A. M. He is therefore visible all through the latter half of the night.

Saturn is about six degrees east of Jupiter, and also visible after midnight. Uranus is in Aquarius, and sets at about 10 P. M. in the middle of the month. Neptune is in Cancer, and is observable in the morning hours.

The moon is in her last quarter at 11 A. M. on the 2nd, new at 5 A. M. on the 10th, in her first quarter at 10 A. M. on the 18th, full at 8 A. M. on the 25th, and in her last quarter again during the last hour of the year. She is nearest us on the 25th, and farthest away on the 13th. During the month she passes near Jupiter and Saturn on the 3rd, Mercury of the 8th, Venus on the 14th, Mars on the 15th, Uranus on the 16th, Neptune on the 28th, and Jupiter and Saturn once again on the 30th.

At 10 P. M. on the 21st the sun reaches its greatest southern declination, and enters the "sign of Capricorn," when, in almanac language, "winter begins."

Destruction of main and super-structure decks, looking toward bow

Effect of a single bomb on main deck. Note that bombs were placed and not dropped

## Bombing the Old Battleship "Indiana"

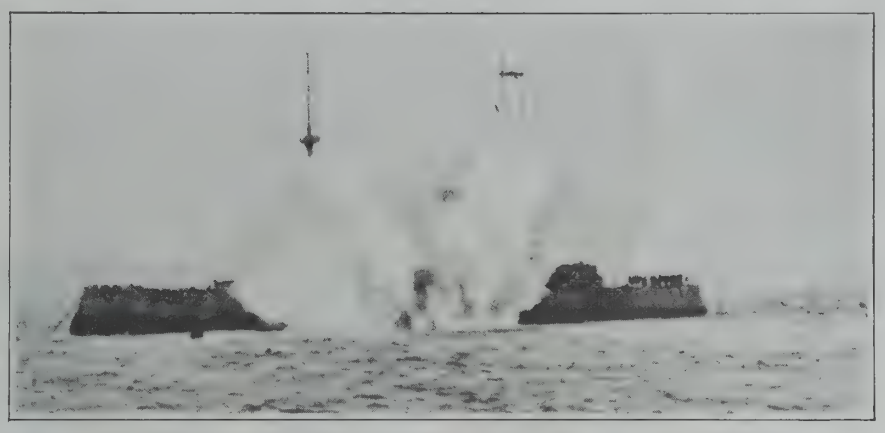
WITH a view to determining the effect which bombs of various sizes would have if dropped upon a battleship, that ancient craft, U.S.S. "Indiana" was selected as the subject of experiment. The "Indiana" class of three ships was laid down in 1891 and completed in 1895. The designs, therefore, of these ships are fully thirty years old, and consequently the "Indiana" has for many years been quite out of date, although she had a refit in 1905.

The vessel is 348 feet long, 69 feet, 4 inches broad, and displaces about 10,300 tons. She has a belt 15 to 18 inches in thickness, carries 17 inches of armor on the barbettes, and 8½ inches on the turrets. Her armament consists of four old 13-inch guns and eight 35-caliber 8-inch guns—at least that was the original armament. She is protected, in addition to the 18-inch belt, by a 3-inch protective deck at the water line and a 5-inch side protection from the water line belt up to the main deck. It should be understood that all of this armor is of the old Harvey type.

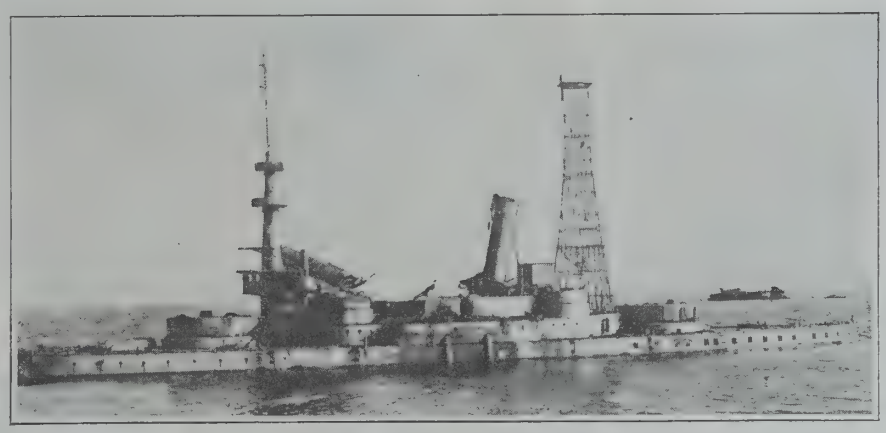
The "Indiana" is to be used by our modern fleet as a target, suffering the same fate as the old "Texas," renamed "San Marcos," the wreck of which can be seen in the offing beyond the quarter deck of the "Indiana" in one of our pictures.

Before subjecting her to gun fire, it was decided to anchor the "Indiana" in shoal water in Tangier Bay in the Chesapeake and cause her to settle upon the bottom by bombing the ship. It should be understood that the bombs were not dropped from airplanes, but were placed in positions, where their detonation would provide the information which the naval authorities were seeking as to bomb destructiveness on certain selected parts of the ship. The bombs were placed both within the ship and outside of it, some of the exterior bombs being in contact with the side of the ship below water and others being detonated at varying distances from the side. The results of this attack can be gathered from a study of the illustrations on this page.

These experiments were intended, not as a trial of bombing from the air, but merely to determine the effect of bombs of varying weight and power, if they struck at certain selected positions, or at varying distances from the ship. The art of bombarding from the air is yet quite in its infancy. To make a hit the plane must descend so low as to be fairly certain of being shot down. If it attacks out of anti-aircraft gun fire range, hitting the target becomes a matter of sheer good luck.



Detonation of bombs below water and near side of "Indiana"



The battleship "Indiana" on the mud where she will serve as a target. The wreck of the target "San Marcos" is seen beyond quarter deck of "Indiana"

**The effect of bombs on structure of "Indiana"**

## Battleship Guns on Submarines

IF anyone six years ago had stated that within a few years' time submarines would be going to sea carrying 12-inch guns, he would surely have been regarded as a visionary. The British Navy showed an astonishing freedom from conservative restraint in its handling of the naval problems which the war developed, and in two directions, that of the battleship and the submarine, we witnessed two remarkable developments, first, in the "Hood," a ship 860 feet in length, combining heavy battleship armor and armament with a speed of 32 knots, and here, in the "M-1," as it is called, in which we have a submarine carrying a gun that not so very many years ago was used only as the principal weapon on board of the most powerful battleships.

Just how far this latter development will go, it is difficult to predict. Lord Fisher, if we remember rightly, believes that the near future will see fleets of submersible battleships—big seaworthy vessels carrying full armaments of heavy guns and capable of entire submergence. It cannot be denied that "M-1" seems to point that way; but until she has been tried out under varying conditions and put to thorough tests of her habitability, seaworthiness, endurance, rapidity of submersion and all-round maneuvering ability, it would be rash to make any confident predictions as to the future of this type.

Although the British have been surprisingly frank in disclosing the particulars of the ships which they built during the war, it is significant that they have said very little about "M-1" and her sisters. In fact, the only definite statement that we have seen was one to the effect that these boats were built specially for service in the Dardanelles, where they were to be sent in for close bombardment of the forts.

The "M-1," a new type of British submarine, mounting a 12-inch gun

## State Friction and Lubricating Properties

IN an attempt to throw further light on an observation made by Rayleigh that, in certain cases, the friction is greater with a large amount than with a minute quantity of the same oil, experiments have been made on the static friction between perfectly clean glass surfaces and on the effect of a number of pure liquids when used as lubricants.

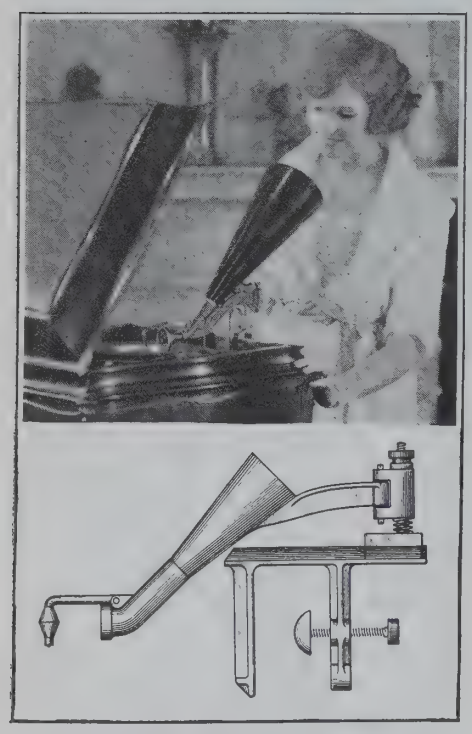
The clean surfaces were found to "seize," and when a sufficiently strong tangential force was applied to cause movement, the first effect was to tear the two glass surfaces. The liquids examined fall into two classes. The first class, the inactive fluids which have no lubricating effect, includes water, ethyl alcohol, ethyl ether, benzone, strong ammonia, and glycerine, but the last substance can exert the maximum lubricating effect if the surfaces are flooded.

Among active fluids were found sulfuric, hydrochloric, acetic, butyric, and oleic acids, a number of organic bases, castor oil, and paraffin. It was noticed in the case of some of the acids that the friction was slightly greater with the surfaces flooded than with an invisible film of liquid.

The evidence is against the conclusion that lubrication is a function of the quantity of lubricant when this is a pure chemical substance and when the viscosity is not very great, we are told.

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*



How the home recorder is used and its mechanical details (diaphragm and cutting tool not shown)

## Home-made Records for the Disk-Type Phonograph

WITH the more or less complete disappearance of the cylinder-type phonograph, there passed away the former possibility of making one's own records—a feature that made for no end of added pleasure for the phonograph owner. The mechanical details of the usual disk phonograph are such as to preclude the making of phonograph records at home except through the use of some elaborate accessory.

It has remained for C. E. Sanders of New York City to develop a practical form of recording device which can be attached to any standard disk phonograph for producing home-made records. Aside from making records of various members of the family, the recorder can be employed for divers other purposes, such as in the school room, laboratory, singing school, and so on. At any rate, this device can be readily attached to any disk phonograph and used by anyone, because of its simplicity.

The starting point in our description of the home recorder is a special soft-wax disk, which is placed on the turntable in the same manner as the usual record. A metal disk, with a fine spiral groove, is placed over the center of the wax disk or blank. The reproducer is made in the form of a resonator and operates a fine cutting tool resting on the soft-wax blank. As the wax blank is turning, the recorder is slowly fed along through the small guide that rests in the spiral groove of the metal disk. Thus a good hill-and-dale cut record is produced, and by using the usual phonograph soundbox the music can be reproduced. Obviously, such a record, being made in soft wax, is not intended for long wear. If one desires to make it permanent, the manufacturers of the new device are prepared to duplicate it in the shellac compounds that we are accustomed to buying as regular records.

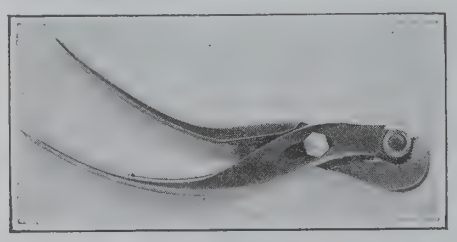
By means of a special fluid it is possible to efface the grooves and create a smooth surface for the next recording. Thus one blank can be used over one hundred times.

In the accompanying illustration will be noted the device attached to a standard disk phonograph, as well as a line drawing of the device itself. In this case the cutting tool and diaphragm are not shown; these members fit at the lower or smaller end of the horn.

A crank-operated shearing machine which expedites this kind of work

## An Interesting Plier Wrench

A WISCONSIN manufacturer has brought out a type of wrench which may be instantly adjusted to fit any size of pipe or nut within its capacity. The arrangement of the two sliding bearings and fulcrum give compound leverage and an exceedingly powerful grip may be obtained. The jaws of this wrench are always parallel. It is particularly adapted to tightening or removing nuts.



Any nut can be firmly held in the jaws of this pair of pliers

## Turning the Crank to Shear the Sheep

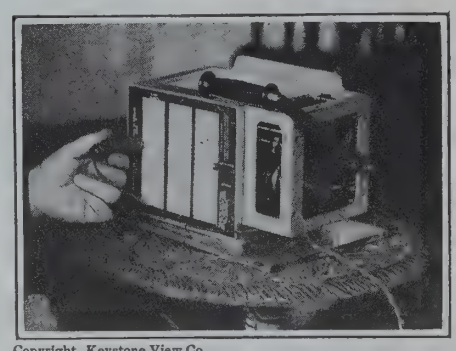
AN ingenious American has developed a hand-power shearing machine which makes short work of this particular task. As will be noted in the accompanying illustration, this device consists of a crank, reducing gears, transmission shafts with universal joints, and the shearing mechanism proper. Turning the crank causes the cutting blades to function. Two men are required with the crank-operated device, one for turning the crank and the other for the shearing.

## Truck With Electro-Magnetic Crane

A MOTOR truck company of Bay City, Michigan, has the distinction of manufacturing the first motor truck equipped with an electro-magnetic lifting crane. The machine has a 4-ton capacity and is a special order. It was tested recently and found to measure up to requirements. It is said that it will do the work of 20 laborers. A special crane was manufactured for this truck in which all operations are performed by power. It is equipped with quick-acting out-riggers in order to insure stability. The motor truck and crane can be used for loading or unloading cars of iron, etc., for handling scrap iron in yards, for loading other motor trucks or drays or for loading the motor truck itself, and can be used as a crane in handling any heavy object. This motor truck was manufactured as a special order for a Detroit concern, and will be sold at a consideration of $12,000.

## A Device That Takes the Place of the Radio Operator

RADIO equipment is absolutely necessary if an airman desires the maximum safety in flying. However, with the radio telephone handicapped by a very limited range, and the radio telegraph necessitating a knowledge of the telegraph code, the installation of a radio equipment aboard an airplane has heretofore presented numerous difficulties.



Copyright, Keystone View Co.

An automatic wireless transmitter which enables airmen to send messages

Now comes F. S. S. Wates of London, England, with an automatic radio transmitter which enables anyone to send certain wireless messages by merely manipulating a plug. The device, which is shown in the accompanying illustration, consists of clockwork driving a series of contact-making wheels, and a plug for making connections with any desired wheel. Each wheel has teeth which represent the dots and dashes of a given standard message, and the aviator plugs into the hole corresponding with the message he desires to transmit, and pulls the lever which operates the clockwork.

The automatic transmitter carries a large number of standard messages, a "forced landing" call, and the names of the leading towns along a given route. Thus if the airman is compelled to descend, he depresses a small lever and inserts the plug into the town nearest the forced landing. Obviously, this device, which weighs but ten pounds, is not a radio transmitter in itself; it must be employed in conjunction with a standard wireless set.

## Taking the Hard Work Out of Sawing

EVEN with the sharpest saw the task of sawing a hardwood board is anything but a sinecure. While our modern sawmills are models of efficiency and labor saving, the carpenter still does his work by tedious hand methods.

So it has remained for Charles M. Geiger of Chicago, Ill., to invent an electrically-operated hand-saw. His labor-saving device consists of a small electric motor which drives a small but extremely sharp saw through suitable means. The saw reciprocates at a high rate of speed, so that there is very little resistance offered to its motion by the wood being cut. In this manner, so we are told, the electric saw can be held in position with the right hand, while the left hand guides the reciprocating blade along.

The electric hand saw which speeds up sawing operations

## Something New in Tire Rims

DESPITE the many ways of putting an automobile tire on its rim, this field still appeals to inventors because the present ways are by no means the last word in convenience and dispatch. One of the latest ideas for tire rims is that shown in the accompanying illustration. Here is an automobile tire rim that can be taken off one shoe and transferred to another shoe in thirty seconds, according to its inventor. It is made in two parts, with two other pieces of the rim hinged together. The rim, when placed on the shoe, is locked with a small lever that works on a swivel at the bottom of the rim. The tire is placed on the rim and the two small sections of the rim are forced together as shown. The little clamp then holds the two sections in place.

A tire rim that can be transferred from one shoe to another in thirty seconds

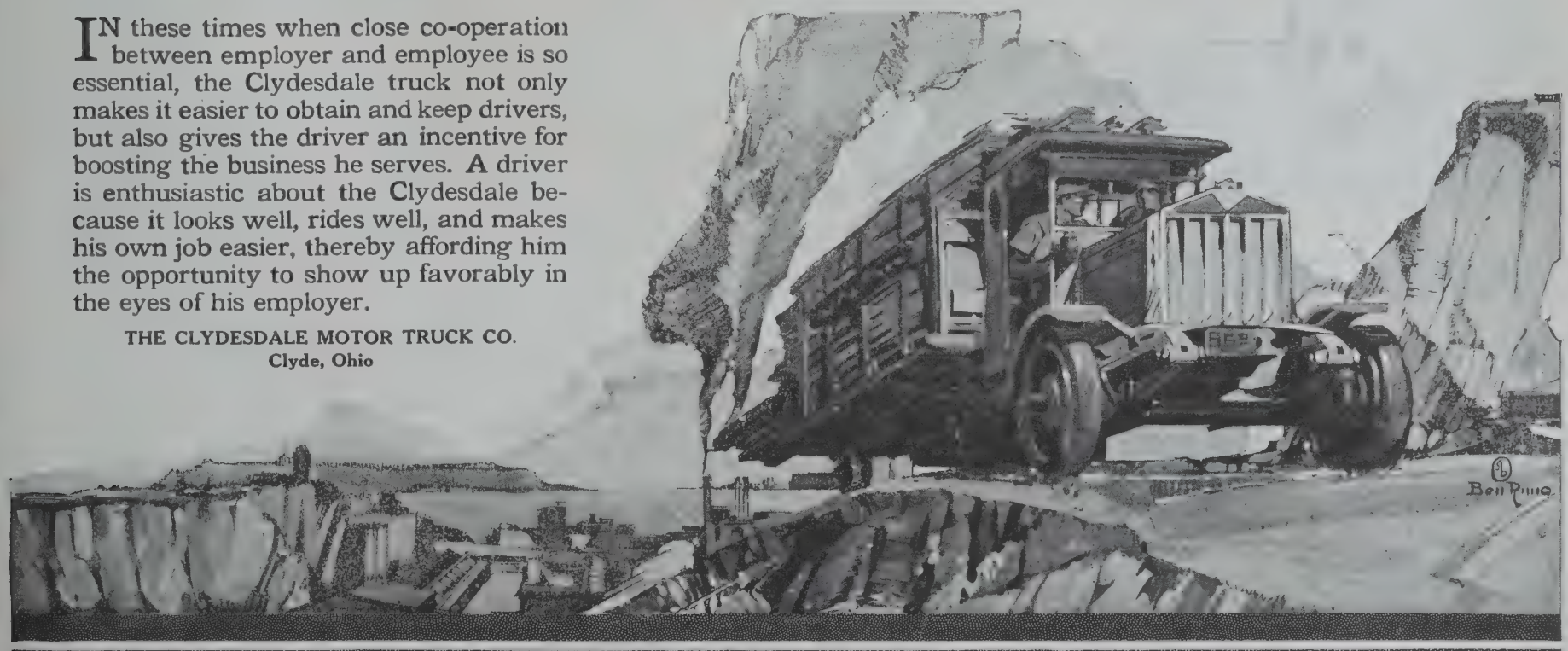
# PERFORMANCE

## WHY DRIVERS SWEAR BY THIS TRUCK, NOT AT IT

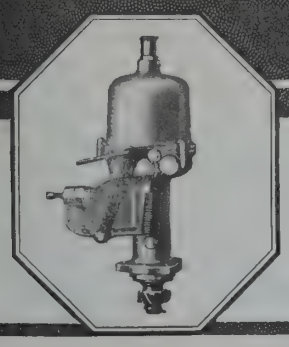
WHILE the purchase of the first truck may not be influenced by the driver's opinion, the performance of that truck in the hands of the driver often determines the selection of a second one. Clydesdale preference among drivers is founded upon two facts—mechanical excellence which includes power, adequate speed and ease of adjustment, together with the Clydesdale Controller which enables the driver to forget everything but the road.

IN these times when close co-operation between employer and employee is so essential, the Clydesdale truck not only makes it easier to obtain and keep drivers, but also gives the driver an incentive for boosting the business he serves. A driver is enthusiastic about the Clydesdale because it looks well, rides well, and makes his own job easier, thereby affording him the opportunity to show up favorably in the eyes of his employer.

THE CLYDESDALE MOTOR TRUCK CO.
Clyde, Ohio




# CLYDESDALE
## MOTOR TRUCKS



**"The Driver Under the Hood."** Just as the locomotive engineer looks to his fireman to see that enough steam is maintained to pull the load, the driver of a Clydesdale truck depends upon the Clydesdale Controller to keep the motor going at whatever speed is necessary to pull the load.

Whether up or down hill, through mud or sand, over rough or smooth roadbed, the Clydesdale will travel at a uniform speed once the throttle is set. On an upgrade, the controller feeds the motor more gas. On a down-grade, it cuts down the gas. All the driver needs to do is steer and shift gears when necessary.

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# Recently Patented Inventions

*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc.*

## Of General Interest

CAN COVER.—J. M. HATFIELD, 1111 N. Penn. Ave., Independence, Kan. This invention has for its object to provide a device especially adapted for enclosing cans of nitroglycerine and other explosives, wherein a relatively soft, flexible cushioning casing is provided for containing the can and for covering every part thereof to prevent the possibility of frictional contact of the can with other objects.

WINDOW CLEANER.—M. GOLDSTONE, 496 Chauncey St., Brooklyn, N. Y. The primary object of the invention is to provide a mechanically-driven window cleaner, which may be used to clean windows or other surfaces at a rapid rate without employing a ladder or for cleaning large show and store windows where considerable surface is exposed and considerable manual labor necessary.

REVOLVING HOUSE.—S. M. STEVENS, 1 Ravenscroft Rd., Asheville, N. C. This invention particularly relates to dwellings adapted for sick persons, or what are known as outdoor sleeping rooms; the object is to provide a dwelling having an open side which may be revolved in order to face in any desired direction. A further object is to provide electrically-operated driving means for revolving the house, the house being fitted with a number of conveniences.

WINDOW VENTILATOR.—F. SCELTZ, P. O. Box 380, Harrison, N. Y. The invention relates to a window ventilator which will permit a free movement on the part of the frame, a filtering element being incorporated with the structure insuring against the entry of impure air, the filter being readily cleanable at all times; the ventilator will also permit of an adjustment of the flow of air.

FILM HOLDER.—C. L. BAMBRIC, Brooks, Alberta, Canada. The object of the invention is to provide a film holder which will maintain a film in a stretched out condition without danger of creasing while allowing an easy washing thereof or dipping into the developing solution. Another object is to provide a holder which is readily adjusted for different widths of films.

MARKING DEVICE.—C. M. GRAVATT, Cold Springs, Okla. Among the objects of the invention is to provide a device which is especially adapted for marking cloth or clothing of any character so as to identify the material or article; it is especially adapted for use in connection with laundry work to distinguish the property of different customers.

TRUNK BAND.—R. T. EMERY, 121 Fellsway, W. Medford, Mass. The invention relates to trunk bands or straps preferably of bendable material which can be positioned around a trunk and securely locked in place, and when in such position will operate to strengthen the trunk and prevent injury as well as prevent opening of the trunk by unauthorized persons. A further object is to provide a device which will not disfigure the trunk.

PERPETUAL CALENDAR.—J. L. HUTSON, Shelbyville, Tenn. The object of the invention is to provide a perpetual calendar adapted to indicate any desired date of either the Julian or Gregorian system. Another object is to permit the user to rapidly set the calendar for any date of past, present or future years. Another object is to permit the user to set the calendar for the present month and to allow of making the desired changes at the end of a month or year for the next ensuing month of a year.

ROADWAY.—A. ANFINSON, Wakonda, So. Dak. The object of the invention is to provide mechanism for use in connection with ordinary country highways, for converting said highways at small expense and in a minimum of time into metaled road ways; to provide relatively narrow tracks of plastic material capable of hardening, such for instance as concrete.

EGG MIXER.—R. G. WILSON, Davis, W. Va. This invention relates generally to mixers, and more particularly to a portable hand mixer for domestic use in mixing fluids and semi-fluids, the object being the provision of a simple, inexpensive apparatus which may be readily cleansed after using and thus maintained in highly sanitary condition.

## Hardware and Tools

DOUBLE CLAMP.—G. T. BENTON, Willow Springs, Mo. The invention relates more particularly to a clamp which may be utilized for various purposes in connection with the fitting and setting of doors, windows and the like, the object being the provision of a simple, effective double clamp of the jointed nature which facilitate certain specific operations in addition to its general application.

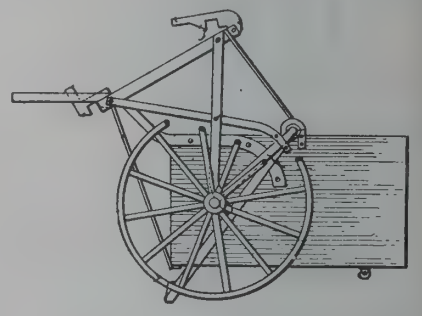
## Machines and Mechanical Devices

PULLEY.—A. SGRITTA, address A. Sgritta & Co., 94 Spencer St., Brooklyn, N. Y. The invention relates to belt-carrying pulleys for the transmission of power, and resides specifically in providing the rim of the pulley with a nurling to prevent the slipping of the belt and the lateral displacement and disengagement thereof, thus effecting a saving in power and economy of fuel, itme and labor..

PUMP.—H. M. HALL, Box 464, Wilcox, Arizona. The invention has for its object to provide a pump wherein the parts are so arranged that the barrel and plunger of the pump, together with the valves, may be easily and quickly detached from the suction pipe, or connected therewith without the necessity of pulling the said pipe from the top of the ground.

## Pertaining to Vehicles

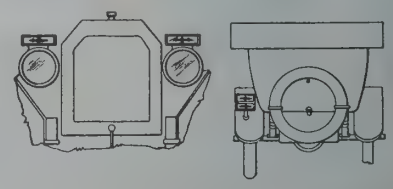
SELF-LOADING COAL AND GRAIN TRUCK.—J. A. KLOVSTAD, Hope, N. D. The invention has reference more particularly to that type of hand trucks that are designed to be self-loading and useful on farms, in cars, and warehouses, its main object being to provide a hand truck that will quickly load itself, and can be transported from place to place with and without its load.



A SIDE ELEVATION OF THE TRUCK IN POSITION FOR BEGINNING TO LOAD

RESILIENT WHEEL.—M. B. DISKIN, 76 W. 3rd St., New York, N. Y. The invention relates particularly to wheels having rigid rims and flexible spokes. Among the objects is to provide a wheel for vehicles which shall possess the desired resiliency for the comfort of the occupants of the vehicle and for practical purposes and yet shall not be subjected to the inconveniences incident to the use of pneumatic tires.

DIRECTION INDICATOR.—R. P. SAFELY, 410 42nd St., Oakland, Cal. The primary object of the invention is to provide an electric direction indicator for motor vehicles which can be conveniently manipulated by the driver or person sitting next to him to indicate to an approaching vehicle the direction that the vehicle is to take, for instance, when making a righ or left hand turn around corners. A further object is to so construct the device that it may be installed on a vehicle as an accessory.



A FRONT AND REAR VIEW OF MOTOR VEHICLE WITH INVENTION APPLIED

TRANSMISSION MECHANISM. — C. A. GROTZ, 4032 N. Francisco Ave., Chicago, Ill. An object of the invention is to provide a transmission mechanism by means of which any speed from zero to a maximum may be obtained by the manipulation of a single member such as a foot pedal or a lever. A further object is to provide transmission mechanism which may be used on all types of motor-driven vehicles, and which eliminates the bringing of gears into mesh and the consequent noise and wear occasioned thereby.

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## That Parallel Postulate

(*Continued from page 565*)

zation which the Euclidean has demanded that we produce, and the one which in the hands of the modern geometer has shown results.

In this two-dimensional geometry of surfaces in general, that of the plane is merely one special case. Certain of the features met in that case are general. If we agree that we know what we mean by distance, we find that on every surface there is a shortest distance between two points, together with a series of lines or curves along which such distances are taken. These lines or curves we call geodesics. On the plane the geodesic is the straight line. On surfaces in general the geodesic, whatever its particular and peculiar shape, plays the same rôle that is played by the straight line in the plane; it is the secondary element of the geometry, the surface itself and all other surfaces of its type are the tertiary elements. And it is a fact that we can take all the possible spheres, or all the possible French-horn surfaces, and conceive of space *as we know it* being broken down by analysis into these surfaces instead of into planes. The only reason we habitually decompose space into planes is because it comes natural to us to think that way. But there isn't a true, honest-to-goodness geometrical plane in existence any more than there is an honest-to-goodness spherical surface: so on intrinsic grounds one decomposition is as reasonable as another.

Certain of the most fundamental postulates are obeyed by *all* surfaces. As we attempt to discriminate between surfaces of different types, and get, for instance, a geometry that shall be valid for spheres and ellipsoids but not for conicoids in general, we must do so by bringing in additional postulates that embody the necessary restrictions. A characteristic shared by planes, spheres, and various other surfaces is that the geodesics can be freely slid along upon themselves and will coincide with themselves in all positions when thus slid; with a similar arrangement for the surface itself. But the plane stands almost unique among surfaces in that it does not force us to distinguish between its two sides; we can turn it over and still it will coincide with itself; and this property belongs also to the straight line. It does not belong to the sphere, or to the great circles which are the geodesics of spherical geometry; when we turn one of these over, through the three-dimensional space that surrounds it, we find that the curvature lies in the wrong way to make superposition possible. If we postulate that superposition be possible under such treatment, we throw out the sphere and spherical geometry; if we postulate that superposition be only by sliding the surface upon itself we admit that geometry—as Saccheri failed to see, as Lobatchewsky realized, and as Riemann showed at great length in rehabilitating the "obtuse-angled hypothesis." Lobatchewsky's acute-angled geometry is realized on a surface of the proper sort, which admits of unrestricted superposition; but it is not the sort of a surface that I care to discuss in an article of this scope.

### Where Euclidean Geometry Stands

Euclidean geometry is the natural and easy one, I suppose, because it makes it easy to stop with three dimensions. If we take a secondary element, a geodesic, which is "curved" in the Euclidean sense, we get a tertiary element, a surface, which is likewise curved. Then unless we are to make an altogether abrupt and unreasonable break, we shall find that just as the curved geodesic generated a curved surface, the curved surface must give rise to a "curved space"; and just as the curved geodesic needed a second dimension to curve into, and the curved surface a third, so the curved three-space requires a fourth. Once started on this sort of


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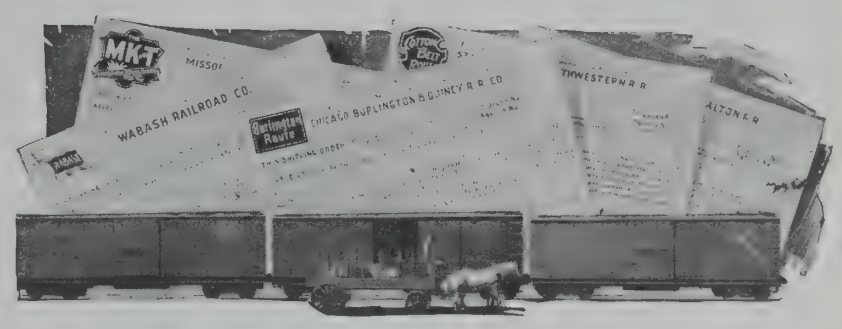


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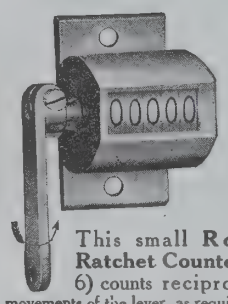

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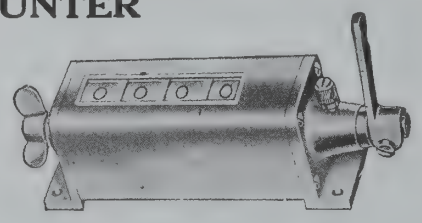

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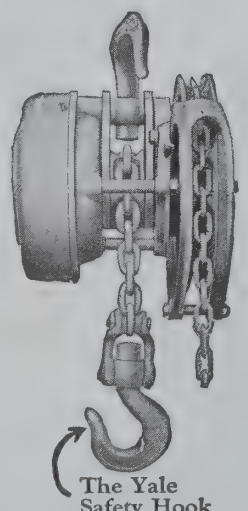

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thing, there doesn't really seem to be any end.

Nevertheless, we must face the possibility that the space we live in, or any other manifold of any sort whatever with which we deal on geometric principles, may turn out to be non-Euclidean. How shall we finally determine this? By measures—the Euclidean measures the angles of an actual triangle and finds the sum to be exactly 180 degrees; or he draws parallel lines of indefinite extent and finds them to be everywhere equally distant; and from these data he concludes that our space is really Euclidean. But he is not necessarily right.

We ask him to level off a plot of ground by means of a plumb line. Since the line always points to the earth's center, the "level" plot is actually a very small piece of a spherical surface. Any test conducted on this plot will exhibit the numerical characteristics of the Euclidean geometry; yet we know the geometry of this surface is Riemannian. The angle-sum is really greater than 180 degrees; lines that are everywhere equidistant are not both geodesics.

The trouble, of course, is that on this plot we deal with so minute a fraction of the whole sphere that we cannot make measurements sufficiently refined to detect the departure from Euclidean standards. So it is altogether sensible for us to ask: "Is the universe of space about us really Euclidean in whatever of realized geometry it presents to us? Or is it really non-Euclidean, but so vast in size that we have never yet been able to extend our measures to a sufficiently large portion of it to make the difference from the Euclidean standard discernible to us?"

This discussion is necessarily fragmentary, leaving out much that the writer would prefer to include. But it is hoped that it will nevertheless make it clear that when the contestants in the Einstein competition speak of a non-Euclidean universe as apparently having been revealed by Einstein, they mean simply that to Einstein has occurred a happy expedient for testing Euclideanism on a smaller scale than has heretofore been supposed possible. He has devised a new and ingenious sort of measure which, if his results be valid, enables us to operate in a smaller region while yet anticipating that any non-Euclidean characteristics of the manifold with which we deal will rise above the threshold of measurement. This does not mean that Euclidean lines and planes, as we picture them in our mind, are no longer non-Euclidean, but merely that these concepts do not quite so closely correspond with the external reality as we had supposed.

### Illiterate Adults

(*Continued from page 566*)

were ignorant of the American language. During the war we have had an additional immigration of a million more adults who cannot speak our language. At present the rate of immigration is larger than during the tidal wave years of 1913 and 1914. The Literacy Test does not exclude illiterates, it merely eliminates some few, for the law makes many exceptions and no ability to read in our language is required. All that is required is knowledge of the simplest words in any foreign language.

The majority of immigrants now find so many of their compatriots here that the incentive to learn American grows less each year. As a rule employment is obtained readily at good wages by the alien without any knowledge of our language, with the consequence that we are rapidly becoming a polyglot nation, and mutual understanding through the existence of a common language is more and more difficult. This leads to increased overhead charges of all sorts in industry, makes a truly representative form of government difficult to attain, prevents industrial cooperation, lowers standards of living, im-


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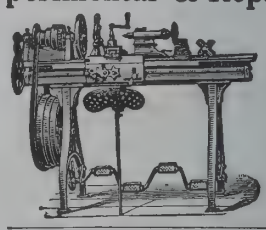

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pairs the health and wellbeing of every community, and even threatens our very form of government.

Heretofore we have prided ourselves upon our literacy. We have taken it for granted that every American could read and write. But the result of the draft showed us that nearly a third of the picked manhood of the nation were unschooled to the point where they could not be accepted as soldiers because they could not understand military instructions of the most elementary sort. Scores of thousands could not distinguish between right hand and left hand. Those who could not read a word included native-born whites and negroes as well as foreign-born.

Slight provision is made in our schools for the needs of the adult. In our public schools, moreover, due to scanty pay, there is a present lack of sixty thousand teachers. This is the condition facing the administrators of education for children under sixteen or eighteen. The additional problem of teaching the adult foreign-born illiterate, the unschooled mountain white, and the negro is so vast that though every one of our seven hundred and fifty thousand public school teachers were to relinquish their work with children and should devote themselves to the instruction of adults who cannot read and write, even then we should not have a force of teachers sufficient to cope with the situation.

Illiteracy therefore is manifestly not the sole business of the schools and the school authorities. It concerns every American. It affects especially the employer, whether in industry or in the household. Half of the illiterates are women, many of whom are employed in factories or in homes.

Evening schools reach only a few of the most ambitious, for the majority of those who cannot read or write or speak our language cannot go to school. Evening schools in New York City have succeeded in the course of a year in reaching scarcely one-half of one per cent of the hundreds of thousands of illiterate aliens. The reasons are many: Industrial fatigue, family obligations, lack of means, and especially faulty school methods and failure to arouse and maintain interest.

A practical and effective method of teaching the illiterate to read is the institution of public school classes in the places of employment. The first workers' class was instituted in 1913 in New York City. There are now more than a thousand such classes in industrial establishments everywhere. In Chicago alone there are several hundred such classes in successful operation. It is not practicable to carry on these classes with complete success unless provision is made for attendance without loss of pay during daylight hours. An hour a day five days a week should be given during the period of instruction.

The latest developments in methods of instruction are Self Help Lessons in American to be put into the hands of the learner himself, and so arranged in method and manner as to be interesting and capable of being used without the aid necessarily of a trained instructor. Such elementary graded progressive lessons provide a language machinery which an adult can use successfully with slight help perhaps from a child who goes to American public school or from some friend who has had a little schooling. Such lessons can eventually be put in the hands of everyone.

It is practicable to develop a One Language Nation as well as a literate nation, but this needs the informed and hearty teamwork of directors of industry, leaders of labor, school authorities, legislators, the press, and the general public.

Democracy is measured by ability of each to share in the thought of all. Today thought is shared by means of the printed word. Therefore inability to read and absence of the reading habit is a barrier to true representation, be it social, industrial, or political. Yet we persistently avoid this obvious fact in our consideration of industrial relations and methods of civil government. The problem of the elimination of illiteracy from the United States is the problem of the most vital importance to us all, for it is basic to national prosperity and is the only means of unifying the nation.

## Motor Trucks in Orchards

(*Continued from page 567*)

be used for different classes of work. In hauling fruit trays, or baskets, for instance, it is found desirable to have a wide platform on the chassis, while for other uses a closed or box body is required. In the raisin district of Fresno County motor trucks are used in large numbers to haul the grapes for drying and again from the drying fields to the packing houses and store rooms. The same is true of the prune districts of the Santa Clara Valley, while in the cherry center, in Alameda County, the trucks are largely used to haul the fresh fruit to market or to the cannery. Lake County is famous for its pears, and here, too, the motor truck is playing an important part in solving the transportation problems of the growers. In the orange and lemon districts of southern California, and the olive district of Butte County, motor trucks are depended upon to move the fruit from the orchards to the packing sheds.

As an example of the adaptability of the motor truck to different kinds of hauling jobs, we have the experience of Mr. Charles W. Mann, a fruit grower of Methuen, Mass. Mr. Mann has four different bodies for his 1½-ton truck, and since its purchase in 1911 this truck has run over 100,000 miles. He uses it to collect thousands of barrels of apples from orchards within a radius of 10 to 15 miles and then to deliver them to nearby markets, to freight cars, or to Boston, 11 miles distant. In one season this truck made two round trips to Boston daily for four weeks, averaging 120 miles a day.

With a double-deck body, Mr. Mann's truck will carry 50 bushels of strawberries or tomatoes without bruising them, and in one season he sold from it 50,000 baskets of berries and 4,000 bushels of tomatoes. The truck also hauled over 150 tons of hay in one season.

That motor trucks will reduce transportation costs has been shown in the experience of many owners. Mr. H. B. Wayland operates an orchard near Heards, Va., and the roads in his vicinity are not particularly good and some of them have high grades. In the old days Mr. Wayland used several four-mule teams for hauling to and from his orchard, and he estimated the daily cost of each of these teams at $5.22 even when idle. He hesitated about purchasing a truck on account of the condition of the roads, sometimes very muddy, but he finally purchased a 3-ton motor truck and in five months this truck covered 2,160 miles before winter closed the roads. The cost figures, in spite of the fact that this five months' work was of the roughest type, including regular road freighting and logging over narrow mountain trails on short, hard hauls, showed a net saving of 10 cents per ton-mile over mule and wagon haulage, and after this experience the mule teams were sold and the entire hauling work of the orchard done with the truck.

In the cranberry marshes of New Jersey the motor truck is doing good service, and in spite of the slippery bogs and the wide stretches of sands, the truck is supplanting animal teams. One such truck made from 20 to 25 complete 4½-mile trips daily during the picking season. The truck has replaced five teams and surpassed the record of the teams by approximately 100 per cent.

In many cases the use of motor trucks has enabled fruit growers to save their


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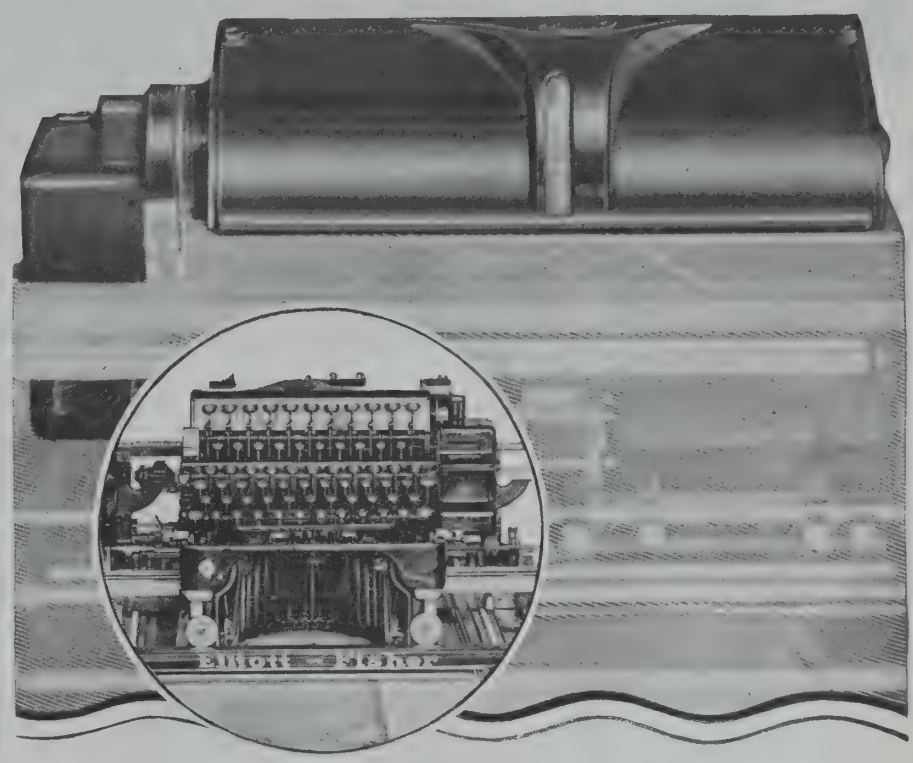

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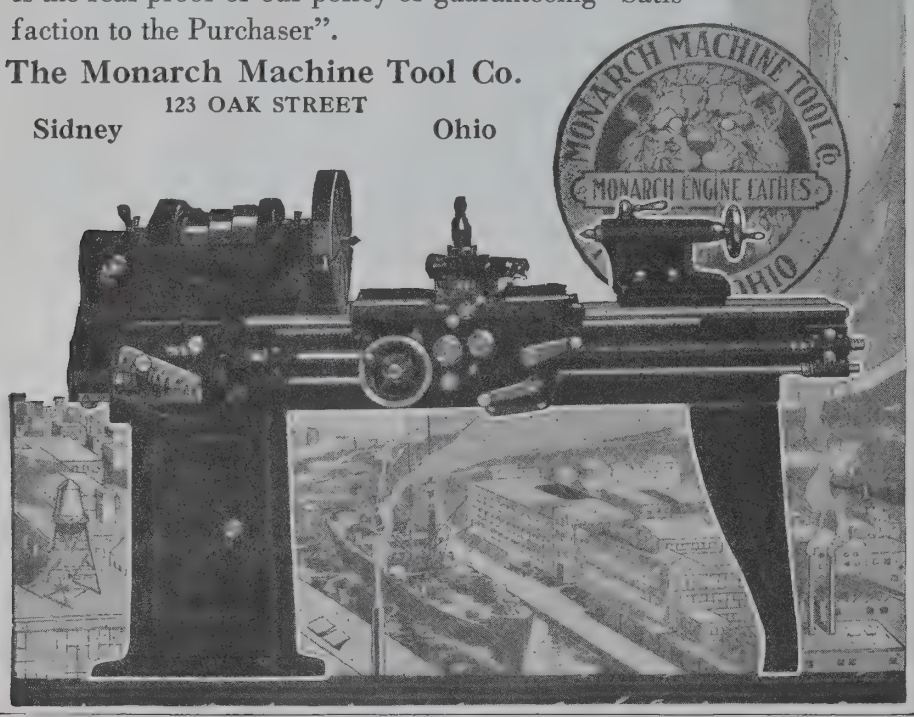



## Cover Crops for Our Orchards

(*Continued from page 567*)

husbandman for the renewal of the corn crop next year.

Not so with the fruit tree. It must serve long years; bear patiently all the vicissitudes of vegetable life; produce fruit abundantly, even in the extremity of old age.

Nor is the fruit tree indifferent to man's care and attention. It smiles its gratitude in terms of vigorous wood growth, luxuriant leafage, a profusion of beautiful spring bloom, and finally a crop of fruit richly tinted and colored to please the eye, and gushing with pleasant juices, wherewith to gratify the appetite of man.

Cover crops may be used handily and effectively in the art of mulching. Mown cover growths gathered about a tree, carefully placed in regular form, and to a proper depth, may be made to serve various purposes—stifle weeds or foul growths that may have sprung up around the tree, conserve moisture by preventing too rapid evaporation; and the refertilization of the soil immediately around the tree, where it is most needed.

Rainfall may thus be absorbed and held in suspension for the better nourishment of the tree; moisture from lower sources may be also brought up and made to do good service. And, as in a hundred other instances the farm tractor comes upon the scene as a most efficient tool to be used in the cultivation of cover crops.

It is both handy to use, and effective in its action. One of the most awkward phases of orchard culture that has come under my own observation was the cultivation of orchards by means of horsepower. Time and again I have watched some unlucky wight tooling a plow, a walking plow at that, and a pair of farm horses beneath the umbrageous roofage of a California orchard. The plowman, grasping tenaciously the two plow handles, plodding mile after mile in a muddy, sticky furrow; now watching the plow and then throwing a quick glance to his team, the occasional jerk on the lines which are hooked over his own neck because his two hands are otherwise engaged, and then emitting a blue streak of profanity for the better guidance of his team and the delectation of chance passersby, was the scene in outline.

A dull and sordid task calculated to exhaust the body and jar the moral fiber with bitter memories. Then the vain attempts to induce those poor horses, as the slow furrowing proceeded, reverently to bow their heads and crawl beneath the tree tops in order that the plowing might be carried nearer the vital parts of the trees!

But why recall those scenes of rustic toil and tribulation of the spirit, when they have passed, or are about to pass into the realms of oblivion and utter extinction?

And now we behold this emancipated son of toil seated cheerfully upon the throne of the farm tractor, gently steering the apparatus between innumerable rows of fruit trees, turning up the mellow mold through which he once plodded with leaden feet and heavy heart. Gently he guides the machine up beneath the low-bending branches until he seems to be in imminent danger of barking the tree.

But no: Never a bark! Neither is the tractor asked to bow its head; because it is headless and has an orchard top to it.

Now as to various plants that are adapted to cover crops under California orchard conditions: There is *Melilatus*, or Bitter clover. This is an early starter, makes a good growth during the winter, sometimes attaining the goodly

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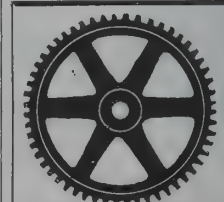

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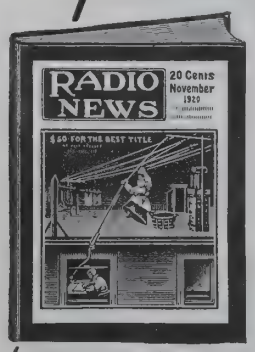


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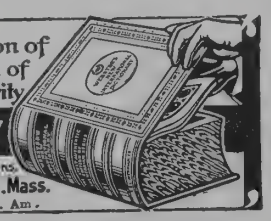

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So he tore up the note and swore he would never reform again. He would steal Jim out of slavery, he would—and if he could think up anything worse, he'd do that too. As long as he was going to hell anyway, he might as well make it worth while. Who ever knew the heart of a boy as does

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height of three feet before it is ready to plow under. It is not good either for hay nor forage but makes an ideal special green manure, or cover crop. Sow from ten to fifteen pounds of seed to the acre, and plant very shallow, say a quarter or a half inch deep.

Burr Clover, or *Medicago denticulata*, is a native of California; makes not only a good cover crop but a fine dry forage for summer use. In practical use the Latin name may be abandoned without endangering the crop.

Spring Vetch, or *Vicia sativa*, is a hardy plant and is extensively used as a cover crop. The seeds are of a large size, and it requires from sixty to seventy pounds to the acre for a proper seeding.

Hairy Vetch, or *Nicia nillosa* is a hardy winter plant; stands cold weather well and makes a luxuriant growth. Sow from 30 to 40 pounds of seed to the acre.

Canada field peas make both an ideal cover crop and a good forage plant for cattle. You may plant it late in the season, yet get a good crop. Sow from 70 to 80 pounds to the acre.

Sweet Clover, or Bokhara, or *Mililotus alba* makes a good cover crop. It is a biennial and is noted for its deep-rooting faculty. Sow ten pounds of seed to the acre.

### Asbestos in Architecture

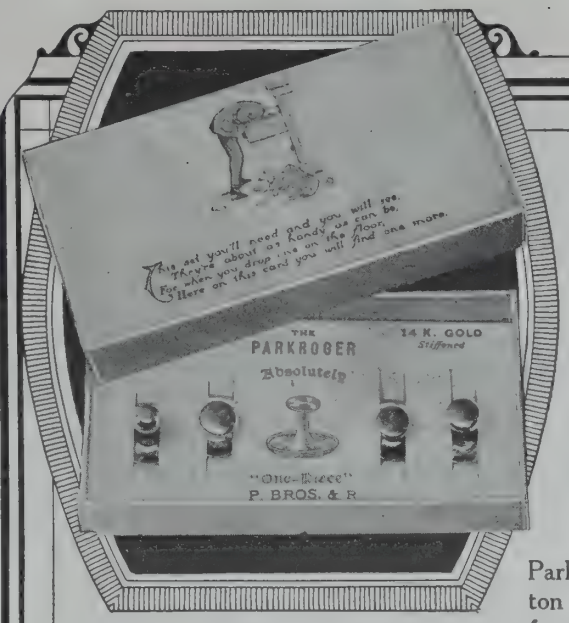
(*Continued from page 572*)

water does not give the desired results, because the asbestos aggregate and the cement particles are drawn together in more or less separate groups or masses. Without going into details, these formations react in such a way to the water that they exclude all but a small percentage of that fluid; and as a consequence the imperfectly wetted mixture represents very largely nothing more than unhydrated cement bound together by a network of more thoroughly hydrated cement "gels." This fact explains why some asbestos shingles, corrugated roofing, and siding have failed to meet expectation.

In the Hatschek process, as standardized here by the best of our manufacturers, the order of procedure is as follows: First, 85 per cent of hydraulic cement of a superior grade and 15 per cent of asbestos fiber of the chrysotile variety are carefully mixed with water by means of a beating machine much like that employed in the production of paper pulp. Prolonged mixing and agitation make a uniform fluid composition having the properties of a colloidal diffusion. The small, solid particles will remain in suspension for a long while. The soft, pastelike mass lends itself readily to working on a millboard machine without setting or hardening the while. It seems that there is no separation of the cement even when the pulp is finally subjected to high pressure. At that time only clear water passes off the rolls.

After leaving the beating machine the colloidal substance goes to a vat where it is kept agitated until picked up by a fine wire screen mounted on a rotating cylinder. From this it is transferred to an endless belt of felt which brings the material between two horizontal steel rolls 96 inches in circumference and 42 inches long, where pressure is applied to expel much of the water. Despite the fact that the surface of the upper cylinder is highly polished, still it attracts the composition away from the felt belt and builds up upon itself successive layers of the substance until the desired thickness is attained. Next, the accumulation is freed from the cylinder by a single longitudinal cut which forms it into a sheet.

Owing to the numerous layers composing a sheet, the manner in which the asbestos fibers are interlocked as the succeeding layers are brought together under pressure and the completeness of the original mixing of the cement and asbestos, a final texture results possessing marked homogeneity and pronounced toughness. But don't let us anticipate.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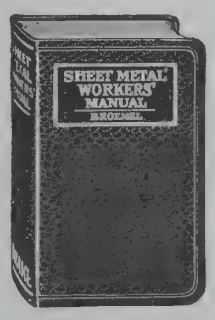


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Every time a car is returned it is washed out thoroughly with scalding water.

When the car is thoroughly cleaned we put 2 or 3 tons of ice and 500 to 750 pounds of salt in the ice bunkers. The salt forces the melting of the ice, which in turn cools the cars.

By the time the car is ready to receive its load, this first ice has largely melted and 2 or 3 tons more of ice and salt have to be put in to keep the car and its contents cool.

The meat is then loaded into the car, great care being taken to see that the quarters of beef and cases of other products are properly spaced to insure a free circulation of cold air. Each 24 hours thereafter more ice and salt have to be put in at icing stations along the way. There must be no failure to keep the ice-boxes filled.

Swift & Company's inspectors keep close check of the cars as they move toward their destination, to see that each one is properly iced. Only through such scrupulous care and attention will meat arrive as it leaves our plants, clean, fresh, and wholesome, unaffected by seasons, weather, dust or contamination.

This is only a part of what Swift & Company has to do in its task of transforming animals into meat products and putting the products in the hands of retail dealers close to your residence.

The importance and magnitude of this work is out of all proportion to the minute recompense which Swift & Company gets, the profits from all sources averaging only a fraction of a cent per pound—less than a nickel a week to the average family.

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After the sheets leave the rolls they are cut up into shingles and "starter pieces" in a way that results in comparatively little waste. These shaped units are then put between steel plates, and when a number of "sandwiches" are ready they are subjected to a pressure of 10,000 pounds to the square inch. This pressure removes the bulk of the moisture and gives the shingles and starter pieces a smooth surface. They are then seasoned, trimmed, drilled, bundled and stored for shipment. The residual moisture does not escape until it has indissolubly bound the cement and asbestos. As the moisture evaporates the shingle becomes more compact and tougher. In short, it grows stronger as time goes on.

In making corrugated roofing and siding the sheets from the rolls are placed immediately between corrugated metal plates and are subjected to a pressure of 20 tons or more to the square foot. This compacting pressure eliminates the minute voids that might otherwise remain in the material. The ultimate product is water resisting. After compression, the material is stored in a damp room to prevent drying out of the surface until the stuff is thoroughly set. Then follows a seasoning period. In manufacturing asbestos building lumber, which is turned out in the form of flat sheets of varying thicknesses, they are naturally placed in the hydraulic presses between flat plates. The lumber, when ready for marketing, can be easily sawed, cut, drilled, punched, and nailed in position. It is employed for walls, ceilings, paneling, and wainscoting. It is also used for doors, screens, pipe and wire conduits, table tops, fire walls, and the lining of elevator shafts, stairways, corridors, etc. Apart from the fact that the material is well-nigh indestructible and non-combustible, it has money-saving virtues, for it can be put in place much quicker than stucco or plaster, does not crack when exposed to the weather, and avoids the expense and labor of occasional painting.

With coal costing more from year to year, the heating of the home and other sheltering structures has become a matter of concern, and it is important to check radiation from the pipes and flues of steam, hot water, and hot-air conduits. This, asbestos coatings are doing but not to the extent that proper economy warrants. Similarly, cold water pipes which might sweat hurtfully in the presence of warmer air can have this tendency arrested by covering them with asbestos; and a protecting shield of this sort upon the water-supply pipes is one of the surest safeguards against freezing and a vexatious bill from the plumber. Again, asbestos jackets, lagging and the like can hold heat at bay in all kinds of refrigerating equipments—reducing outlays for either ice or initial energy, according to the system. Finally, asbestos building felt is an admirable substitute for the inflammable felts or papers now so commonly used as a floor lining and a general sealing medium in frame houses. Owing to its character as a non-conductor, this insulating felt serves also to arrest the penetration of heat in the summer months, thus making for a cooler habitation.

While the United States is the greatest user of asbestos products, our own mines yield less than 1 per cent of the raw material worked up here. It is said that Canada furnishes the world with 90 per cent of the marketable asbestos, and we use 60 per cent of the output of the famous Quebec mines.

## NEW BOOKS, ETC.

ELECTRO-DEPOSITION OF METALS. By Dr. George Langbein. Translated by William T. Brannt. New York: Henry Carey Baird and Company, 1920. 8vo.; 863 pp.; 185 engravings.

The entrance of this standard work upon an eighth edition has provided opportunity for a complete revision and a substantial enlargement. It contains encyclopedic information on electroplating, galvanizing, and electrotyping, the contact and immersion processes, coloring of metals, lacquering, and grinding and polishing. Shop equipment receives much attention, and not the least valuable feature of the work is the practical formulas and trade secrets that cover the solutions employed. Descriptions of machinery and apparatus are freely augmented by good illustrations, and the whole presentment is so plainly worded as to be immediately understandable to the plater and metal finisher.

ARTIFICIAL LIGHT. Its Influence Upon Civilization. By M. Luckiesh. New York: The Century Company, 1920. 8vo.; 366 pp.; illustrated.

It is hard for us to realize into what Egyptian darkness sundown plunged our world not so many years ago. The torch, the candle, the oil lamp, gas, electricity—this historical progress is entertainingly chronicled by the author. He tells of street lighting, home illumination, and artificial light in warfare and in spectacular effects. As usual, he has a word to say on lighting as a fine art; and he discusses light in its relations to health and safety, with some consideration of costs, and a chapter on the light of the future. This story of man's conquest of darkness is stamped with the ease of accurate knowledge and the ability to interest the general reader.

THE LIFE AND WORK OF SIR HIRAM MAXIM. By P. Fleury Mottelay. New York: John Lane Company, 1920. 8vo.; 230 pp.; illustrated.

The author was secretary to Sir Hiram, who furnished, by personal dictation and by manuscript accounts, much of the information that makes up the volume. Each section deals with a particular phase of inventive activity—the automatic gun, explosives, aerial navigation, gas machines, oil experiments, etc. Lord Moulton's introduction draws a picture of the man and inventor as he knew him, and an excellent frontispiece portrait shows Sir Hiram at the age of seventy-four. Appendices contain valuable notes and cite the list of patents granted the subject of the biography by the American and British Governments.

AMERICA'S MARITIME PROGRESS. By George Weiss and J. W. Leonard. New York: The New York Marine News Company, 1920. 4to.; 525 pp.; illustrated.

Large pages, tinted paper, good print-work and fine plates make very attractive this history of our wonderful rehabilitation. It recounts how American shipping pulled out of the plight in which it stood before the war, and shows how coöperation and standardization led to the breaking of building records and a forward leap in foreign commerce. Four-fifths of the work is devoted to descriptive sketches of representative companies of the shipping world, with biographies and photographs of the big men of the industry. Among the full-page plates are shipyard scenes, launchings and various types of our great cargo carriers.

AERONAUTICS. Fourth Annual Report of the National Advisory Committee for Aeronautics, 1918. Washington: Government Printing Office, 1920. 4to.; 654 pp.; illustrated.

The report gives a clear account of facts collected and verified and work done. The methods and machinery of important experiments are closely described, and there is a lay-out of general problems and activities with the trend of progress indicated. The technical papers, occupying the major portion of the large volume, include Nos. 24-50, and deal with nomenclature, navigational theory and phenomena, air propellers, general construction, tests of balloon fabrics, gas, and engine fuels, and other experiments and deductions. All interested in aircraft should follow recent development as here authoritatively outlined, and learn what our coöperating experts accomplished.

OCEAN SHIPPING. Elements of Practical Steamship Operation. By Robert Edwards Annin. New York: The Century Company, 1920. 8vo.; 427 pp.; illustrated.

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IN THIS ISSUE:

FROM WOOD TO CLOTH
MUSIC FROM GLASS

# SCIENTIFIC AMERICAN

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INDUSTRY · SCIENCE · INVENTION · MECHANICS

MEASURING A YEAR'S CROP OF SNOW IN THE CALIFORNIA AND NEVADA MOUNTAINS. [See page 594]

Vol. CXXIII. No. 24
December 11, 1920

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20 cents in Canada

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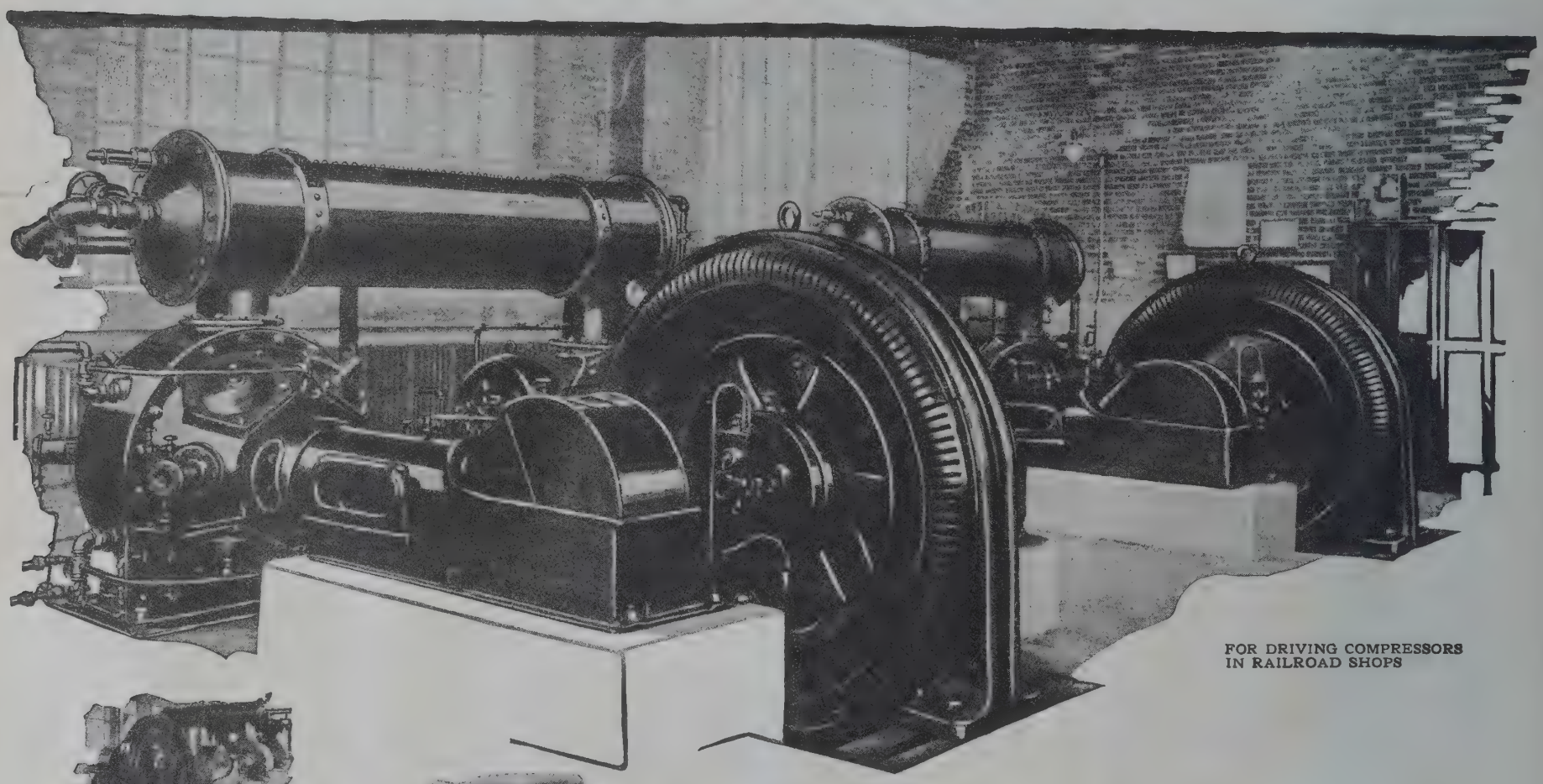

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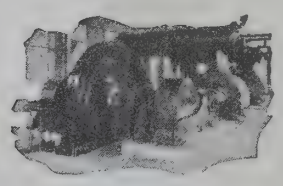

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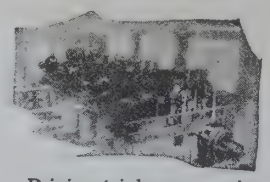
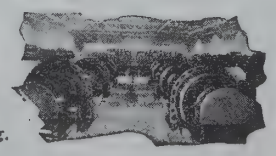


Driving triplex pumps in concentration mill of a copper company.

And for driving refrigerating machines.



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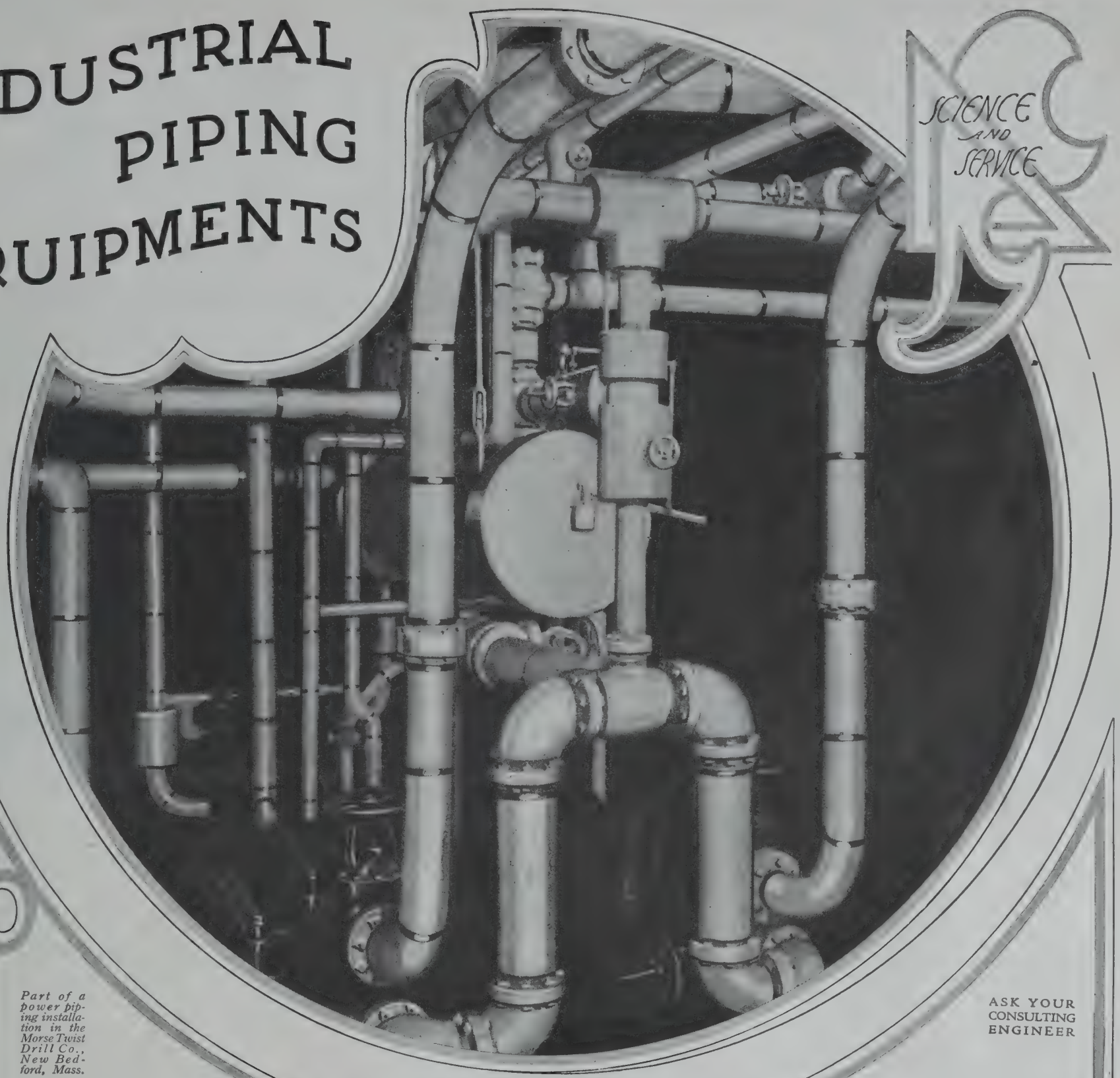


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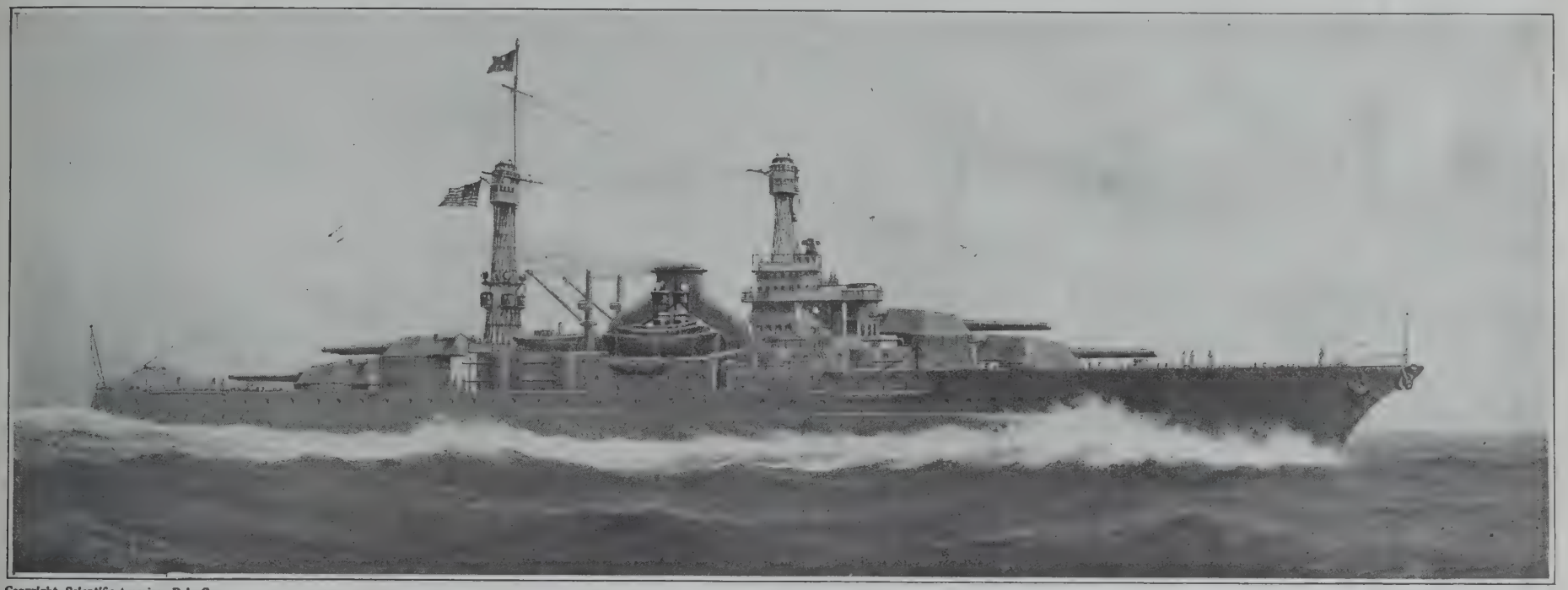
SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXIII. NUMBER 24 ] NEW YORK, DECEMBER 11, 1920 [ 15 CENTS A COPY 20 CENTS IN CANADA



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*Length over all:* 684 ft. *Beam:* 105 ft. *Displacement:* (Max.) 45,000 tons. *Speed:* 23 knots. *Armor:* Belt 16 in.; gun positions, 14-18 in. *Armament:* Twelve 50-cal. 16-in. guns; sixteen 53-cal., 6-in. guns; four 3-in. antiaircraft guns; torpedoes, 2. *Officers and men:* 1,500.

**The new "Indiana"—Our latest design of battleship, one of a class of six**

## The New Battleship "Indiana"

IN our issue of November 13 we described and illustrated the "Tennessee," which, with her sister, "California," will be the last United States battleship to carry as her main armament the 14-inch gun. The Navy Department has done more or less work upon our next class, consisting of the four battleships of the "Maryland" type, which will be the first to mount the 16-inch gun. In size these ships will be about the same as the "Tennessee." The principal difference will be that they will mount eight 16-inch guns in four 2-gun turrets instead of twelve 14-inch guns in four 3-gun turrets. The names of the vessels of this class are: "Maryland," "Colorado," "Washington," and "West Virginia."

The fine illustration shown above represents the latest class of battleships to be designed by our navy. Six of them are proposed, namely, "Indiana," "Iowa," "Massachusetts," "Montana," "North Carolina" and "South Dakota." As it will be evident from the details given below, these will be the largest, most heavily protected, most heavily armed battleships that have yet been designed for any navy. The length between perpendiculars will be 660 feet, and the length overall, 684 feet. For the first time in our navy, the beam will exceed 100 feet, the exact measurement being 105 feet. This is the practicable limit, as determined by the usable dimensions of the Panama Canal, which has a clear width in the locks of 110 feet. It will be seen that there will be a clearance of only 2½ feet on each side when one of these vessels makes the passage of the canal locks. The mean draft will be 33 feet and the normal displacement with a two-thirds supply of stores and fuel and a full supply of ammunition on board will be 43,200 tons. The full load displacement will be in the neighborhood of 45,000 tons. The motor power consists of twelve White-Forster oil-fired boilers and two sets of Westinghouse turbo-electric drive, and the current will be generated in two main generators and distributed to four motors on the four propeller shafts. The estimated horse-power on trial or, to be more accurate, the shaft horse-power is 60,000 and this is expected to give the ships a trial speed of 23 knots.

Particular attention has been paid in these ships to the protection of their stability and flotation. To safeguard against torpedo attack below water, the space between the outside skin of the ship and the interior hull containing the magazines, boiler rooms, engine rooms and steering gear, is divided by several, continuous, watertight, vertical walls or bulkheads of steel, which extend unbroken practically from end to end of the ship. The bottom edge of these bulkheads is riveted to the inner floor of the double bottom. The upper edge is riveted to the under side of a heavy steel protective deck, located at the water line. Intersecting these longitudinal bulkheads at frequent intervals are transverse bulkheads, which extend from the outer skin of the ship to the bulkhead enclosing the engine and boiler rooms, magazines, etc. Thus, the whole of the elements of the "Indiana" which are essential to her proper functioning both as to speed, maneuvering and fighting, are surrounded by a vast multi-circular, watertight, and immensely strong steel cofferdam which, it is believed, is so efficient that the new "Indiana" can take the blow not only of one but of several torpedoes without being sent to the bottom. Coupled with this is an exceedingly powerful pumping plant with connections which would enable any portion of the ship to be drained of inflowing water. So much for the anti-torpedo protection.

For protection against gunfire, the "Indiana" carries a belt which extends from well forward on the foremost turret to well aft of the after turret, and reaches from several feet below the waterline up to the gun deck. The thickness of this armor has not been disclosed. It is not less than fourteen and may be sixteen inches. The protection to barbettes and turrets is on the same generous scale. Associated with this side armor are several steel decks, designed to exert sufficient retardation upon plunging shell fire, to set off the delay-action fuses and reduce the shells to fragments before they reach the protective deck.

The main battery of these ships has been planned on the same liberal scale as every other element. It consists of twelve, 50-caliber, 16-inch guns, mounted in four 3-gun turrets. The new 16-inch is an exceedingly powerful weapon. It is about 70 feet in length; it weighs over 130 tons, and it fires a shell weighing 2,100 pounds with an initial service velocity of about 2,800 feet per second. Its maximum range is so great as to exceed visibility from the firing ship, and, consequently, the fire will have to be spotted and directed for these extreme ranges from spotting airplanes flying above the enemy. The firing of these guns will be done upon the director-fire principle. The traversing and elevation of the guns will be determined from fire-control stations at the top of the cage masts, and no longer will the gun pointer stand at each individual gun with his eye glued to a telescope the cross hairs of which he endeavors to keep upon the waterline of the enemy ship. All this will be done by an officer using his single directorscope at the top of the mast. There are two fire-control stations, one at the top of the fore, the other at the top of the main mast. Each has two enclosed decks, the upper deck for the control of the main batteries and the lower deck for the fire-control of the secondary battery which consists of sixteen 6-inch, 53-caliber guns. These guns are arranged mainly in sponsons on the main and on the spar decks. Four are located forward in sponsons, abreast of the foremost and navigating bridge; eight are arranged in superposed sponsons in the after part of the super-structure, and four others are mounted in the open, two on each beam, abreast of the navigating bridge. There will also be four 3-inch, 50-caliber, anti-aircraft guns, and two submerged 21-inch turbo tubes will be carried. At present prices the cost of each of these ships will be over 40 million dollars.

The most novel feature, and one which will readily distinguish these ships from others of the navy, is the curious bifurcated smokestack. The uptakes from the boilers lead two large transverse flues at each end of the boiler rooms, and from the center of these rise two semi-circular, curved smokestacks which are drawn

(*Continued on page 601*)

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## To Save Our Shipping Fleet

As a result of the investigation of the Shipping Board operations, the public, no doubt, is by this time pretty thoroughly discouraged, if not disgusted. The revelations of incompetence, extravagance and dishonesty on the part of contractors, climaxed by the statement of one of the Shipping Board's leading officials that no less than two billion dollars has been wasted, is one of the most humiliating disclosures in the whole history of this republic. The mitigating fact, of course, is that the ships were built in wartime as a war measure and under conditions quite unprecedented in the history of merchant shipbuilding. The fate of the war, and therefore of civilization, hung upon the question of our ability to build ships faster than the enemy could sink them. You cannot conduct industrial operations under such conditions and expect to realize the economies which are possible in shipbuilding under peace conditions. This fact must never be forgotten in passing judgment upon the amazing extravagance which marked the operations of the Shipping Board up to the time of the armistice. No such plea, however, can be made in extenuation of the continuance of these conditions in times of peace.

It is futile, however, to repine over the folly and blundering of the past. The question confronting the nation is what to do today in straightening out this enormous tangle. We should lay to heart the outstanding lesson of the whole thing, which is that Government operations of utilities are always extravagantly costly. It was the enormous extent of the Shipping Board's operations that brought this fact home to the public with startling and stunning force. So, the very first thing to be done is to get these ships out of Government control and place them unreservedly in the hands of private operators. They should be sold at once, and when they have passed into the hands of the private owner, he should be left to run these ships according to his own knowledge and judgment.

Long before the armistice, Mr. Hurley, then chairman of the Shipping Board, strongly advocated this policy. Had the ships been sold at the close of the war, when there was an urgent demand for shipping and a scarcity of bottoms to carry the world's commerce, the United States Government could have sold these vessels at the then prevailing high rate, and the loss per ship would have been no more than reasonable. To a certain extent this policy was inaugurated and certain valuable contracts had been drawn up and were practically ready for signature, when proceedings were interrupted by the anti-ally propaganda of a notorious newspaper, and the negotiations fell through.

Since those days the inevitable fall in the price of ships and in freight rates has come about, with the result that the Shipping Board's vessels can be sold today only at an enormous loss, and this at a time when a large portion of its fleet is idle for want of freight.

The investigation above referred to has disclosed that many ships are being operated very expensively and wastefully. There seems to have been no proper system of accounting, a fact of which the grafter or the scoundrel, wherever he has happened to be, has taken the utmost advantage. Matters cannot go on as they are. There is call for instant and sharp decision. If you ask the experienced shipping men of the country, you will find them practically unanimous as to policy. They will tell you that we should sell the ships at once for what they will bring; that they should be sold to experienced shipping companies who will know how to run them to the best advantage; and that the relation of the Government to our new merchant marine should be the same as that which it holds to any great American enterprise—a relation advisory, helpful, and protective.

## Our New Army

WHATEVER may have been the differences of opinion on Mr. Baker's policies preceding and during the war, there was a consensus of opinion as to the great ability he displayed in presenting any debated subject—the facility with which he could unravel a complicated question and present it in clear and forceful English. The same quality is displayed in a marked degree in the annual report of the Secretary which has recently come to hand. No one can read this report in full, or even somewhat cursorily, without having a very clear idea as to what has been accomplished in the reorganization of our Army.

Mr. Baker tells us that the Army is essentially a new army, not merely another army from that which existed prior to the war, but new in its attitude toward the country and the country's attitude toward it. He claims that the extent to which a new era has dawned for the Army is shown by the results of the Army recruiting. We are assured that the difficulty in securing the necessary enlistments for our small prewar army has in large part disappeared; and, although the stimulus of the active operations of war has now entirely disappeared, the total strength of the Army on November 3, 1920, was 213,067.

We are not surprised to learn that the one-year enlistment period which was authorized by Congress has failed to give results, and that from the point of view of the efficiency of the Army, one-year enlistment periods are of little value. Short term service with the colors, which might serve under a universal training system, in the nature of things can never produce the efficiency which is necessary in the troops of an enlisted regular army. The term of enlistment should be lengthened.

In reviewing the military activities of this country since 1776, the Secretary tells us that, in spite of the fact that the United States is the most peace-loving of all nations, it has been engaged in major, domestic or foreign wars about one out of every four years during that long period. From this he draws the conclusion that while we do not need a great standing army, we must take the world as we find it and try to make it what it should be. Hence, we must have a body of trained men large enough in numbers to be an effective working model upon which great armies could be swiftly built in case of an emergency. A justice-loving people, says the Secretary, may be forced by tragic necessity to resort to war; but it is not right to ask its sons to fight its battles out-armed and out-shielded by their adversaries.

We are told that the War Department in its study of the lessons of the World War has proceeded on the accepted theory, that the infantry remains the backbone of the Army; although at the same time certain other arms of the service were greatly increased in importance by the swift developments of the conflict now past. Fundamental changes in armament have taken place and many of the instrumentalities devised are apparently only at the beginning of their development.

In this connection, we draw attention to the fact that one of our contributions to the development of war weapons was the motorization of artillery and transport. While the allies had done some work along this line, our Ordnance officers worked out a very ambitious system for the complete motorization of artillery up to and including the very largest types of guns. The same thing was being done with transport, and it is our hope that the policy will be followed out. Although it is true that the infantry have maintained their position as the backbone of the Army, it is also certain that the necessity for close coördination between infantry and artillery, not merely field but also heavy artillery, was greatly emphasized on the fields of France and Flanders. The army which possesses the most mobile artillery and transport, other things being equal, will hold a commanding position.

A well-earned tribute is paid by the Secretary to the work done by American women in the war. "All over France during the war," says he, "it was possible to find these serene, dignified, and helpful women; and I know no more knightly fact than that, from the beginning to the end of that great experiment, there is no recorded instance of an indignity or an incivility from a soldier to a woman." This is a fine tribute to the women who served in the various agencies built up around the soldier and his needs.

## Why Is A Patent?

THE governmental departments that act as agencies for the collection of the revenue—the customs and the internal revenue—are of course expected to bring in more money than they pay out.

A casual observer would not hesitate to say that no other governmental bureau could possibly be expected to show receipts in excess of expenditures. The Government is not in business for itself or for a profit—it is in business for all of us and for service. Certainly the War and Navy Departments, that supply us with the service of protection, are not to do this at a profit. Surely the Department of Justice does not expect to create a financial profit out of the pursuit and conviction of moonshiners and conspirators in restraint of trade. The Departments of the Interior and of Agriculture and of Commerce and of Labor like to feel that the American people as a whole, through taking advantage of what the departments do for them, save and win sufficient in the course of a year to make the departments a net cash asset to the country at large. But if you asked the Chief of the Bureau of Plant Industry or the Commissioner of Lighthouses or the Director of the Census or the Public Printer why their offices do not show an operating profit, you would get a properly indignant reply.

Even the Post Office, doing business on such a vast scale and at such rates that a profit from operations would seem well-nigh unavoidable, has usually managed to avoid this, and when it has so far transgressed governmental properties as to take in more money than it paid out has promptly made arrangements to remedy this condition by enlarging the scope of its nonprofitable services. Here, as in general throughout the Government, the whole theme is to give service—service that shall be profitable to the country at large, and for which the country at large, rather than the direct beneficiary, therefore pays in taxation.

To this benevolent policy, however, there is one shining exception, as pointed out by Mr. William Wyman on another page. The Patent Office, from almost its inception, has been conducted at a direct profit. For some mysterious reason it always is assumed, whenever the needs of this office are being considered, that of course the revenues from the office will meet all the expenses of conducting it, and a little bit more. We wonder what would happen if our courts were conducted on the same principle—if the question of adding a needed member to the Interstate Commerce Commission or bringing the salaries of the Justices of the Supreme Court up to a proper basis was made to depend upon the extent to which additional funds might be obtained through a revision of court fees and fines?

The fundamental fallacy seems to be that the Patent Office is selling something to the people with whom it deals, and that they must pay the cost of that thing. We have exposed this fallacy often, and shown clearly that the whole position of our country in the world depends upon the supremacy maintained by our inventors in spite of every discouragement.

The Patent Office is not selling goods to inventors. It is granting to inventors what is theirs by virtue of a provision in the compact known as the Constitution of the United States. If it is intended to withdraw this as a right, and replace it by a privilege to be sold only to those who can pay for it, let us come out in the open and amend the Constitution; let us state explicitly that, like France, we regard the inventor solely as an object of taxation and after we have got out of him all we can, do not care what becomes of him. If it is not intended that this be the basis of our patent system, let us put the Patent Office on a footing of equality with the rest of the Government.

## Naval and Merchant Marine

**Italian Flotilla Leaders.**—In the opinion of some authorities, the latest Italian flotilla leaders to go into commission are the most powerful in the world. With a displacement of from 1,900 to 2,200 tons, they are comparable to the British "Scott" class. Three of the boats mount three 6-inch and four 3-inch guns, and the fourth carries six 4.7-inch guns, which may be compared with the armament of five 4.7-inch guns in the latest British fotilla leaders. The contract speed of these boats, 35 knots, has been exceeded.

**Improved Gunnery in the Navy.**—Analysis of the gunnery exercises of the American Navy during the past year shows that the greatest progress toward efficiency was made by vessels of the battleship class, due to the larger number of men aboard such ships and the comparative stability of the personnel. The Navy Department considers that battleship gunnery is at present about equal to that of foreign battleships. It is believed that next year vessels of other classes will be brought up as regards gunnery to the level of our battleships.

**The Minimum Requirements of the Modern Dreadnaught.**—Speaking editorially the *Naval and Military Record* says that British naval opinion is almost unanimous as to the material elements which qualify a capital ship for the first rank. These are: First, a main battery of not less than eight guns nor of less than 15-inch caliber; second, for battleships, armor protection that will resist the heaviest armor-piercing shell at ranges exceeding 12,000 yards; third, an all-round bulge defense against torpedoes; fourth, for battle-cruisers a sea speed of not less than 30 knots.

**British Dominions and Navy Policy.**—The various British dominions, and particularly Canada, New Zealand and Australia, are giving much attention to the question of naval defense. There is a tendency to muster out the older units and keep in commission only the latest types of warships. The question of future increases is awaiting the decisions of the Meeting on Imperial Defense, which will be held next year, at which all the dominions will be represented. It is likely that the plan of imperial defense drawn up by Lord Jellicoe will be accepted with certain modifications.

**Monument to Dewey at Manila.**—Rear Admiral Casey B. Morgan, Commandant of the naval station at Cavite, P. I., in a letter to the governor of the Philippines, refers to the absence of any monument or public improvement in the city of Manila bearing the name "Dewey"; which lack of suitable civic recognition has been a matter of wonderment and amazement to him and to other officers who have been associated with these islands since the earliest days of our occupation. It is amazing that such neglect of the deeds of this great naval officer should exist.

**Admiral Benson to Masters of Ships.**—Admiral Benson has recently made public a message to all seafarers of the merchant marine, in which he draws attention to the reduction in ocean freight movement and makes an appeal for a spirit of coöperation under the present conditions, so that foreign competition may be successfully met. He urges masters and chief engineers, port captains and port engineers "to take the utmost interest in the operation and proper repair of the vessels in their charge." He urges them to keep their ships in seaworthy condition, to effect quick turnaround, to reduce the cost of repairs, and avoid overtime. He reminds them that without such increase in efficiency an increasing number of vessels must be tied up.

**Battleship Versus Torpedo Plane.**—Commenting on certain articles by "Quarterdeck" in the *New York Tribune*, in which the abandonment of the superdreadnaught, if not the dreadnaught itself, was advocated, Rear Admiral Fiske says that most of the men who oppose the strenuous development of aeronautics have not carefully studied its possibilities. He agrees with "Quarterdeck" that this is the time to "stop, look, listen," and study thoroughly the possibilities of the new art. He believes with many others that aeronautics is destined to bring about "a revolution in warfare, in comparison with which the revolution brought about by the invention of the gun was like a vaudeville performance." Pretty strong words these for an admiral! At the same time, no naval man is better qualified to speak on this subject. Admiral Goodrich writes to the same paper that if he understands "Quarterdeck," this is the moment for careful investigation, for which ample time exists. He believes that it is not the time for continuance and enlargement, and the present building program may be found to be unwise.

## Astronomy

**The Laws Observatory** of the University of Missouri, erected in 1853, has been torn down, and a new building is being erected to replace it about half a mile south of the former site.

**Periodic Variations in the Brightness of Jupiter,** due to the different markings presented to us in the course of the planet's rotation, though necessarily very small, are within the range of observation of the photo-electric cell. At the Berlin-Babelsberg Observatory P. Guthnick found by this means last December and January a variation having an amplitude of 0.14 magnitude. This variation had, however, diminished to 0.04 magnitude a month later.

**The Warner and Swasey Observatory.**—On October 12, 1920, occurred the formal dedication of the fine observatory presented to the Case School of Applied Science, Cleveland, by the Warner & Swasey Company, and called in honor of the donors the "Warner and Swasey Observatory." An address was delivered by Director Campbell, of Lick Observatory. The new observatory contains a library and a full instrumental equipment, including a 10-inch refractor, of which the object-glass was made by Brashear and the mounting by Warner & Swasey.

**Warner & Swasey.**—The name of this American firm of telescope-builders is a household word among astronomers, who will be glad to add to their libraries a booklet which the firm has published on the occasion of its 40th anniversary, giving a history of its development from the usual small beginnings. Many astronomers will be astonished to learn that telescope-making is almost a negligible fraction of the business of this great establishment, the chief product of which is the turret lathe. Similarly, meteorologists who visit the "Belfast Observatory" factory of Messrs. Julian P. Friez & Son, in Baltimore—remarkable for its architecture and appointments, as well as for the work done there—are usually much surprised to discover that the making of meteorological instruments is a side issue in the business of the concern.

**Longitude Determinations by Airplane.**—M. Paul Ditisheim has recently published the results of his latest experiments in determining differences in longitude by means of chronometers carried in an airplane; the experiments in this case having been made in May, 1920, between London and Paris. Twelve small "deck watches" were used in the experiments, after having undergone rigid tests at the National Physical Laboratory and at Greenwich Observatory and having proved to be of exceptional accuracy. These were carried 5 times by airplane between the English aerodrome at Croydin and the French at Le Bourget, the trips between the aerodromes and the observatories of Greenwich and Paris, respectively, being made in automobile. On these journeys the time-pieces were carefully packed in a valise, which M. Ditisheim, with the aid of a spirit level, maintained in a horizontal position. Corrections were applied for temperature and altitude. The mean result of all the determinations was 9 m. 20.947 s., while the mean of the best previous determinations by other methods is 9 m. 20.952 s.; in other words, the airplane method gave a result for the difference of time between London and Paris differing only .005 second from the standard value.

**Nova Cygni No. 3,** which was of magnitude 3.5 when discovered by Denning on August 20, 1920, and rose to a maximum brightness of 1.8 on August 24, remained visible to the naked eye for less than a month. It is gratifying to record that members of the American Association of Variable Star Observers obtained 287 observations of the brightness of this star, covering every day of the month during which it was a naked-eye object, and, at first, almost every hour. Early in November the star was still visible in small telescopes, being of about mag. 9. The history of the star before August 20 has been published by M. Felix de Roy in the *Observatory*. It is not found on a photographic plate taken June 3, 1905, which shows stars down to the 16th magnitude, nor on a plate of the same region taken July 20, 1920, showing stars down to the 11th magnitude. A Harvard plate taken August 9, 1920, including stars down to the 9th magnitude, does not show the nova, but appears as a 7th magnitude star on a plate taken by Nils Tamm, in Sweden, August 16, and as a star of mag. 4.8 on a Harvard plate taken August 19, the day before its visual discovery. M. de Roy calls attention to the fact that novæ have, of late, been more plentiful than comets, and that four of these objects are now visible in telescopes of moderate aperture: viz., Nova Cygni No. 3, Nova Aquilæ No. 3, Nova Lyræ and Nova Ophiuchi No. 4.

## Engineering

**More Power from Water Resources.**—A large hydroelectric plant of 20,000 horse-power has recently been completed by a French hydroelectric company. The new plant is located at Seyssel, Haute-Savoie. Importance is attached to the completion of this project because of the present scarcity and high price of coal, and likewise because of the effect it will have toward encouraging similar undertakings in France. The new plant is equipped with four turbines, each capable of developing a force of 5,500 horse-power. It is proposed to install another turbine at an early date, and thus increase the production to 27,000 horse-power, an amount that equals almost one-third of all the energy consumed under different forms by the city of Lyons.

**Pressure of Concrete on Forms.**—A pressure-gage devised by A. T. Goldbeck and used for the last few years in measuring earth pressures behind retaining walls and under fills, has been applied successfully to the measurement of the pressure of concrete on forms embedded therein. The gage consists essentially of an air-tight metal cell having a circular weighing face 10 sq. inch, in area, according to the *Engineering News-Record*. The concrete pressures against the face of the cell are balanced by admitting compressed air to the inside of the cell. When the pressures are balanced an electrical contact is broken which extinguishes a light and signifies that the pressure shown on the gage connected with the air pipes is equal to the pressure of the concrete.

**Making the Most of Natural Reservoirs.**—From Australia comes the news that Torrumbarry weir will immediately serve an important purpose. At the present time large areas in Victoria are served by natural reservoirs known as the Kow Swamp and the Lerang Lakes. When the Torrumbarry weir is completed the level of the river will be considerably raised, and it will become possible to replenish these natural reservoirs when desired. Another important work contemplated at an early date is the construction of a weir for the diversion, when necessary, of waters into Lake Victoria. This lake provides one of the finest natural storage basins along the whole length of the river. The object here will be to fill this basin during times of plenty and then, as the river later recedes, to discharge its contents back into the river for the use of the settlements in South Australian territory. Thus the water instead of being allowed to escape will be regulated to suit the requirements of the irrigation settlements.

**Concrete in Cold Weather.**—This is the time of the year, says *Engineering News-Record*, when warnings about frozen concrete should be more freely given. When it is definitely and continuously cold only the most ignorant and careless will attempt to make concrete and remove forms without due respect for freezing, but now the warm mid-day is apt to make the constructor forget the cold mornings and cold nights which retard setting just enough to reduce strength below the safe limit. An added warning may be worth while. The only certain way to insure against cold weather in concreting is to provide heat—heat in the aggregate and in the water and heat in the structure during the setting period. There are chemicals which lower the freezing temperature of concrete, but their advantage is indeterminate and at best small. Little dependence can be placed on them as a total defense. They may serve as a partial defense when temperature reductions are small, but if their use leads to neglect of more certain precautions they inspire an unwarranted confidence.

**Maintaining the Dirt Road.**—There is little local stone in the Canadian province of Saskatchewan, hence the question of roads resolves itself into importing supplies at a considerable expense or resorting to dirt roads. As far as rural roads are concerned, the cost of the former practice is prohibitive, and the dirt type has been widely adopted. Recognizing the limitations of an earth road with regard to the permanency of its surface, the question of providing a serviceable earth road becomes largely a question of maintenance, and because of the quick deterioration of such a road, especially in wet weather, its maintenance must be continuous. This, we are told by the *Road-Maker Excavator and Grader*, can be accomplished effectively and cheaply by a proper use of the road drag. The work has to be done repeatedly, and, although there is little improvement to show for two or three draggings, a season's work gives manifest results, and the improvement continues with each successive season that the dragging is kept up. The work in Saskatchewan has been encouraged by the institution of an annual competition. The average cost of road dragging in 1914 was $6.28 per mile; in 1919 $9.04 per mile.

General view of shipways, looking northeast from main wharf. There are fifty shipways at Hog Island

# The World's Greatest Shipping Terminal?

## Or Will Hog Island Merely Stand as the Record Junk-Pile of All Time?

By William Benjamin West

*ADVERTISEMENTS appearing in the daily papers recently indicated that Hog Island is on the market. We have seen what happened to other items of war-time salvage of which the Government countenanced the dispersal or sale. But Hog Island, it seems, ought to stand in a class by itself, as the one by-product of the war which possesses inestimable value to the American people. Whether it is sold or not, every precaution ought to be taken to see that it remains in use to the greatest possible extent of its vast capacities.*—THE EDITOR.

THE plan of building fabricated ships had been advocated by leading engineers for years, and when it was found that we were compelled to have ships built within a short time, the construction of ships in this way seemed the only thing to try. But existing yards were not adequate and a new yard had to be built.

Through authorization from the Federal government, a careful investigation of all the proposed sites for a plant was made. After considering the different prospective places, Hog Island, a barren waste of land about 10 miles from City Hall, Philadelphia, was finally selected for the largest of these yards.

The main aim was to build ships, build many and build them quickly, for our country was needing them, and needing them badly, so nothing was spared. What can be seen now at that shipyard is evidence that something must have been going on there during our time of belligerent activity. Approximately 35,000 people were employed in the construction of the plant. Personal observation as to the organization and detail that is carried out at present, even though the war is now over, leaves the impression that the operation of the yard was carried out as efficiently as could have been done under the trying circumstances.

From a barren island of waste land in the summer of 1917 to the largest shipyard in history one year later, in spite of the terrible weather conditions encountered, and almost unsurmountable difficulties overcome, is a record seldom if ever equaled in the history of American industry. And Hog Island has continued to build ships after we withdrew our forces from France and the records show that her trend of efficiency has constantly been upward ever since the present management took charge.

After the first ten ships were constructed the unit cost continued to decline and finally the latter part of the programme was completed at considerably below the unit cost and in a part of the time spent on the first lot of ships. However, it is not for the writer to either uphold or criticize certain phases of the work at Hog Island in this article, but rather to describe certain interesting features of its construction and outline the general plan of operation.

The original area of Hog Island was 846 acres. The purchase price of this tract was $1,706,000. In 1918 an addition of 81.14 acres was made to this by the purchase of what is known as the west impounding basin at the west end of the original property on the water front, for the purpose of pumping from dredging in the wet basin.

With the construction program fully completed, there are 50 shipways at Hog Island. They are divided into 5 groups of 10 ways each. The total area of the 50 ways is 1,529,560 square feet. Some of these ways are of wood and some of concrete construction. The piers between ways are 37 feet wide and vary in length from 132 to 324 feet. There is a wide pier between each group of 10 ways which is 142 feet wide. The total area of the ways and piers is 442,193 square feet. There are 7 piers 100 feet wide and 1,000 feet long (on the short side of the pier) in the wet basin. It is these piers which certain authorities are recommending for use as a terminal at Philadelphia after the closing down of the shipyard. These 7 piers which are used for outfitting the ships after they are launched have a total area of 747,271 square feet.

The administration buildings, office buildings on ways and elsewhere, have a total area of 1,200,000 square feet. The utility buildings, fire houses, electric substations, guardhouses, water stations, etc., have a total area of 150,000 square feet. There are 90 acres of steel storage yards, 58 acres of equipment storage yards, and 5 acres of coal storage yards. The total area of all these yards is 153 acres.

There are two separate and distinct water systems at Hog Island, a high-pressure system for fire protection and industrial use, and a domestic system for drinking water, etc. The high-pressure system consists of two pumping plants. The capacity is 19,000 gallons per minute; normal pressure 62.5 pounds; fire pressure 125 pounds (with pumps connected in series). There are 270 hydrants and 86,000 feet of piping from 2 to 16 inches in diameter.

The domestic system consists of one pumping station and one filtration plant. Its capacity is 2,000,000 gallons per 24-hour day. The source of both systems is the Delaware River. The filtration system is the rapid sand gravity type through which water is sedimented, filtered, and chlorinated. This system has a storage capacity of

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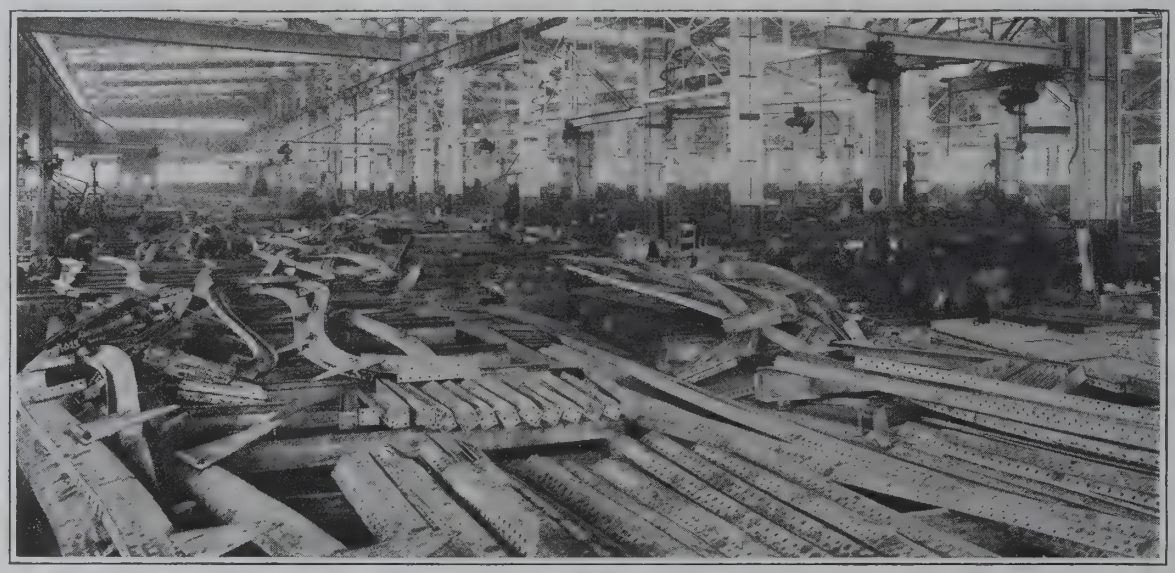

Looking through the center bay of the plate and angle shop, showing the great manufacturing possibilities of the Hog Island plant

Bird's-eye view of the Hog Island shipyard, showing the wonderful terminal facilities of this plant. The fifty ways are seen in the upper right-hand corner

## From Wood to Cloth

By Samuel J. Record
Professor of Forest Products, Yale University

CLOTH made from wood is of interest in this country chiefly because of its novelty. A few suits of "wooden" clothes have been imported from the Central Empires and during the "over-all campaign" against the high price of wearing apparel considerable attention was devoted to them because of their cheapness.

Low first cost is about all that such clothes have to recommend them, except as a passing fad, or in times of great emergency when cotton, wool and other standard textiles are wanting. Germany experienced such an emergency and wood-paper textiles proved to be better, very much better, than nothing. The users of such material came to it with suspicion and, for the most part, had as little to do with it as possible. The principal objection to it was that it wouldn't wash and the objection was well founded, especially at first.

Wood is a fibrous material and its essential constituent is the same as that of cotton, namely cellulose, though not in nearly so pure a state. The Germans were able to purify wood cellulose, however, and use it as an acceptable substitute in the manufacture of gun cotton. Wood has also been used for years in the manufacture of artificial silk, an industry which has become of very great importance. In the latter use as a textile material, all trace of the fibrous structure of the wood is obliterated and an entirely different substance is obtained.

It is a comparatively simple matter to reduce wood to its component fibers since the cementing substance that holds them together is readily dissolved by certain acids and alkalies without material injury to the cellulose of the fibers. In spruce wood the length of fibers varies from one-tenth to one-fourth of an inch with an average of about one-eighth of an inch. In some other woods they are a little longer or a little shorter, but apparently too short for spinning directly into yarn or thread, though the Germans claim to have devised a method for doing it. The usual way is to convert the fiber into paper and then spin paper strips into yarn.

In paper-making wood is reduced to fine fibrous pulp, which is felted together into a sheet and ironed down. Different kinds of paper vary enormously in their strength, toughness, resistance to wetting, etc. News-print paper, which is very weak and brittle, is made mostly of ground-wood pulp, that is, the wood is reduced to

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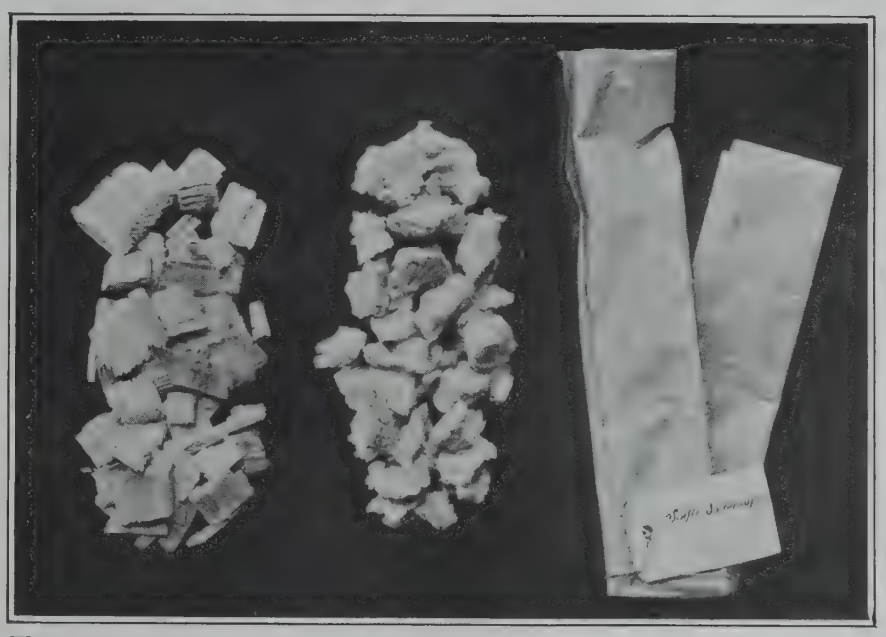
**A 60-foot Burden water wheel at Troy, N. Y. A giant among water wheels and a symbol of the era preceding the hydraulic turbine**



**Three stages in the manufacture of spinning paper: 1. Spruce wood chips. 2. Spruce wood pulp made by cooking chips in acid. 3. Spinning paper made from the wood pulp**

## A Giant of Old

By J. Flagler Wright

THE modern turbine water wheels differ from old-time water wheels particularly in the fact that the new machine receives power water around pretty much the whole of the circumference, whereas the old style wheels received it either at a single point or else through a limited arc. No doubt, the extension of the region of application of power water is a principal factor in the efficiency of the more recent appliance. However, the old wheels deserve our respect. It is also possible that they embodied features which are capable of development under present-day circumstances.

One of the most notable of the old machines was the old Burden Water Wheel at Troy, N. Y. This fellow was the greatest of all American water wheels belonging to the period preceding that of the hydraulic turbine. The diameter of this giant was about 60 feet. It was of the over-shot type. That is, the water impinged on or near the summit of the wheel. There was a central hub to which 264 iron rods were attached. These extended in approximately radial directions, somewhat like the spokes of an ordinary carriage wheel. These were, at their outer ends, secured to the wooden rim.

Unlike a good many water wheels of the older time, the Burden wheel did not exert its drive through a central, or axial, shaft. Instead, the drive was effected on the two sides near the periphery. That is, a gear rim of the spur type was arranged on the two sides of the water wheel. The diameter of each was 56′ 4″; so that the drive was effected by wheels almost as big as the water wheel itself. This arrangement of peripheral drive eliminated torsion troubles with the main shaft. By using what was in effect a big spur gear on both sides, the wheel was stressed evenly. The big gears each meshed with a small spur gear on a shaft. The shaft was arranged in front of the face of the great wheel and about half way down between the level of the center and the level of the bottom. On one side, the shaft was prolonged greatly. At the end was mounted a big spur gear called the bull wheel. It meshed with a small gear on the same shaft with a 20 foot flywheel. By means of a bevel gear turning with the flywheel and a second bevel gear on a long main shaft, the latter was rotated. This mainshaft, as perhaps the reader has already surmised, was set at right angles to the axis of the water wheel.

The water to drive the wheel was

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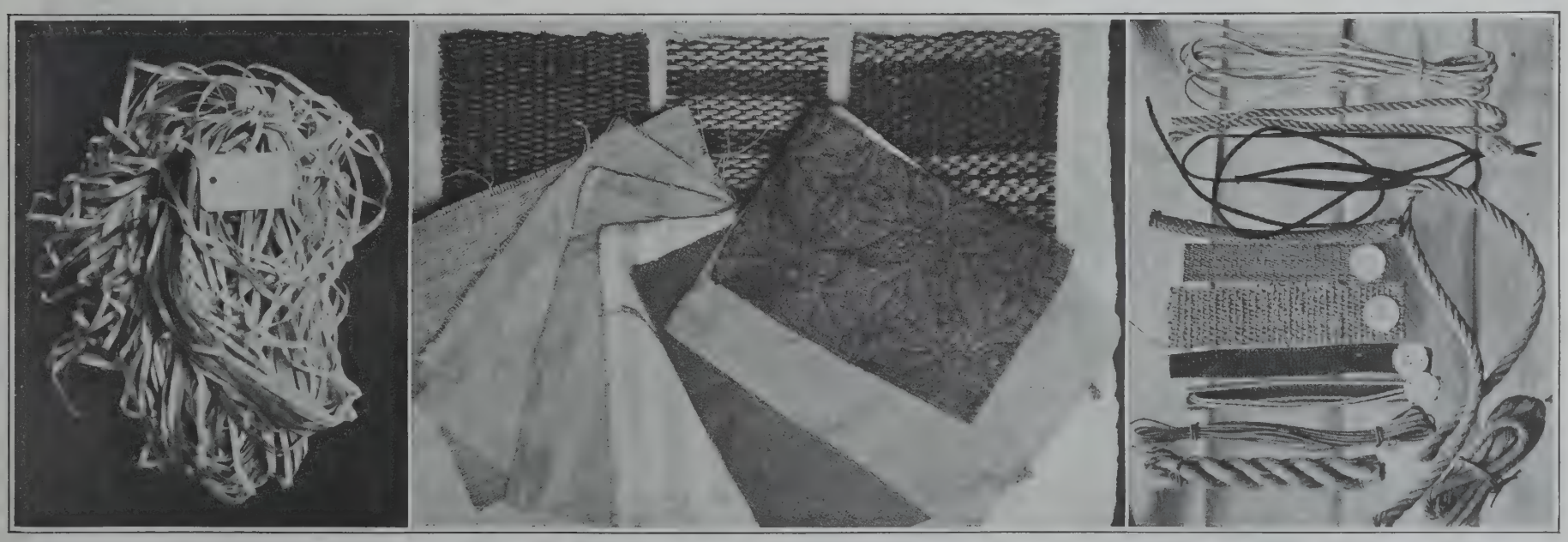

*Left:* Ribbon of paper which is to be spun into paper yarn. *Center:* Miscellaneous paper cloths. On top is a wall covering. Beneath in the order shown, are bed sheeting, work clothes, curtain goods, and sail cloth. The coarsely woven goods beneath are rugs and hall runners. *Right:* Paper textiles, twine, rope, shoe laces, braid and harness straps.

**Paper ribbon for making paper yarn and some of the paper products which are finding their way to our markets**

# The Needs of the Patent Office

## Results of the Insistence that This Most Vital Government Bureau Pay an Operating Profit

By William I. Wyman, Chief Clerk, U. S. Patent Office

THE imperative need of the Patent Office is a new attitude. The argument that has most been used to obtain support for its requirements is that it pays a profit into the Treasury. That the Office makes a profit is conclusive that the inventor is being deprived of something due him. But the fact that should be of the most signifisance is that the Office, as the center of the patent system, is a vital factor in the industrial progress of the country; and its needs should be treated with that consideration solely in mind. The general government pays out scores of millions of dollars for education, scientific research, promotion of agriculture, publications of more or less cultural value, and for various like purposes. But for the medium that is the most direct incentive for increasing the industrial capacity of the people, the government sees to it that it does not spend a red cent. In fact, it plays safe by assuring to itself that the Patent Office shall always be conducted at a profit.

The obvious and more immediate needs of the Patent Office are more room, better equipment, and a larger and more adequately paid force. The building is crowded to-day. There is practically no room for the expansion for the business and the records. The examining divisions are jammed, the files occupy every nook and cranny of the building, the clerks do work in close and uncomfortable quarters, and the library, search and record rooms are filled to capacity. Immediately there should be planned provision for a new building or for enlarged quarters. Even if more room were authorized at once, the pressure of constricted space would become critical before the additional accommodations could possibly be made available. The necessity for quick action is, therefore, very plain—the penalty for delay very apparent.

The equipment of the Office is antiquated and insufficient. The furniture, filing cabinets and shelving, and general office appliances are about the worst in the government service and require modernization and extension. This is particularly true of the storage of copies of patents, the Scientific Library, the records in the manuscript and assignment divisions, and the files throughout the Office.

The clerical force is at present inadequate to do the business of the Office. A 15 per cent increase in numbers with a fair advance in salary to hold and acquire good personnel material would be sufficient to relieve the present unsatisfactory status. As for the technical corps, (the examining service of the Office) a much larger increase in numbers than is provided in the Nolan Bill, now in conference, is desirable if any permanent improvement is to be secured in the character of the examination. If more than a fair scrutiny of the art is to be observed, if something approaching a critical examination of the vast printed records of the advance in industry is to be undertaken, the field of search must be much more limited to the individual examiner and he must be given much more time to study the records and make up his decisions. Especially is this the case in the more technical arts, such as the chemical, electrical and process departments.

It goes without saying that the rapid overturn of the scientific men in the Bureau is disintegrating and disruptive in the highest degree. Any advance in salary that would retain a substantial percentage of the large numbers who now resign to receive greater compensation in private practice would save the industries of the country many fold the advance in pay. At present, this is the most disturbing situation in the Office, but may be remedied if the Nolan Bill (referred to above) passes Congress in its original shape.

These are the most obvious inadequacies and they require immediate remedial treatment if the Office is to perform its most elemental functions with even a minimum amount of satisfaction. Failing this, in any particular, the public must face a continuance of the irritating, insufficient, dilatory and costly conditions which now entail such a needless hazard upon American industrial progress.

The requirements just specified are those necessary for merely carrying on the ordinary functions of the Office in accordance with the accepted standards of the last two generations. To correct the glaring deficiencies so enumerated would merely give the public the service it normally expects and is entitled to. These urgent needs attended to, the public would then receive expeditious responses to their inquiries, and the aggravating and inadequately paid force and poor equipment would be corrected. But the usefulness of the Office is far from being limited by the installation of these merely remedial measures. It can multiply its effectiveness immeasurably through its extension of its functions and changes in its methods.

The Office to-day lacks effective organization. There are 60 or so divisions, about 50 being technical and the remainder clerical. The Commissioner is in direct control of the technical divisions and exercises his administration of the clerical divisions through the Chief Clerk, who, in turn, shares with the primary examiners the control of the clerical personnel in the examining division.

It is utterly impossible with this arrangement for the Commissioner to have an intimate knowledge of the conditions existing in the many units into which the Office is divided. For purposes of administration and to make the actions of the examiners more uniform (now so objectionably diverse) it would appear to be decidedly advantageous to combine the divisions into groups. The associated divisions could be grouped to accord with the related arts. Questions of assigning of applications, simplifying the search, associating the related literature and making available the technical and legal knowledge of the corps, could be more readily disposed of. The files could be kept more systematically and the clerical and messenger work be made more elastic to accord with any change of condition. The executives of the Office could exercise a more intelligent and intimate control over the actions of a small number of large divisions than over a great number of diversified and small units. And that such intimacy of control is needed is well known to all observers and is in accord with general experience.

Another defect in the organization is the mixture of functions exercised by the Commissioner. He is at once the administrative and legal head of the Office, and as the duties in both capacities are heavy and involved, one or the other suffers in their exercise. Without a change of method, such a sacrifice of one of his dual rôles is inevitable. The writer's suggestion is to lodge the entire *active* administration in the hands of the Commissioner and to control the legal program of his office by requiring the Assistant Commissioners, who shall hear *all* cases that come up to the Commissioner on appeal, to report and obtain his approval of all decisions that involve a commitment to any change of legal policy or radical legal action. Those cases that involve the substitution merely of the appellate tribunal's judgment in place of that of the tribunal below could all be tried and decided by the Assistant Commissioners. Only such decisions which would commit the Office to a new course of procedure, or which would constitute leading cases should be referred to the Commissioner for his approval or criticism. Such decisions should be published over the name of the Commissioner and they would comprise the means by which, without undue expenditure of time and labor, he could thoroughly exercise his legal control and leave time for the execution of any administration program, no matter how involved or ambitious.

Inseparably connected with reorganization is adequate room, effectively rearranged to carry forth any advanced scheme. To execute the group plan, to provide that there shall be no lost motion in the movement of the work, to assign and locate responsibility in the duties to be performed, and to bring the clerical divisions into efficient coöperation with the technical departments and into effective relationship with the public require a structure planned on radically new lines. Subsidiary to this, but dependent upon any new plan of building devised, is that of equipment. The means for storing the records and files and for transferring messages and papers could, if comprised of modern appliances, provide for tremendously better service in the way of expedition and accuracy. Especially is this so in the matter of storage of printed copies of patents. These should be placed in a central location according to the stack system, in compact arrangement and in connection with devices to provide accurate placement and quick deliveries.

Without a permanent force no reorganization, no reequipment, will be sufficient. It goes without saying that adequate salaries should be paid to avoid a constantly shifting personnel. It is not too optimistic to hope for such a development in public opinion as will abolish politics in the appointment of the Commissioner. With a comparatively fixed personnel, it is possible to develop an administrative policy and to increase the usefulness of the examiners to any reasonable degree. That deep knowledge of an art that comes from extended practice therein could be made available to the public by such means as the compilation of card indexes, or the publication of brochures on various phases thereof (to mention only a few suggestions that come to mind). With a staff of men attached permanently to the Office, it would be a good investment for the public to assign them at various times to inspect and "live" with the industries in order to acquire the "atmosphere" of their arts and a practical point of view. With a permanent and adequate force of scientific and enthusiastic men, there is almost no limit to the extent of valuable service they could render to the industries of the country.

Another highly desired consummation is the completion of the reclassification and a rapid review of it after completion to iron out inequalities and inconsistencies. Once that is done, and the classification fairly standardized, it is possible to brief the inventions and publish abridgments of them, as is done by the British Patent Office. Or patents unabridged could be bound in classified arrangement and form valuable compendiums of the arts. The last-named service would be particularly desirable, as it would simplify a perplexing branch of the copy-sales activity and would become a double convenience to the public and the Office.

The extent to which the Scientific Library could be improved is limited only by the powers of the imagination. In connection with digests made by a permanent corps of examiners, it could, with a comparatively small additional expense, as appropriations go now-a-days, form a research laboratory for the development of facts on all published subjects pertaining or relating to the applied sciences. It should contain the best and completest fund of scientific information in the world, should have the necessary room and equipment for proper functioning and expansion, and should be provided with expert and adequate direction and assistance.

The Patent Office should also emulate other scientific bureaus of the government. It should get into intimate touch with the people, scientific establishments and the industries. It should have the services of experts in technical specialties at its beck and call and should have laboratories for testing disputed questions of utility of invention. It should issue publications from time to time explaining developments of arts as some of them become unsually active or vital, and should provide, by general and gratuitous distribution in pamphlet form and in popular language, information as to the patent system, the necessity of being capably advised before proceeding with an application, and an indication of the

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*THE question has been asked very often of late years, "What is the matter with the Patent Office?" Almost as many different answers have been given as distinct answers. Certainly the Office is ridiculously undermanned and underpaid; certainly it finds it more than difficult to get Congress to pay serious attention to its plaints. Mr. Wyman, we think, puts his finger on the root of the trouble when he points out that where other departments spend and are expected to spend many millions against receipts that are practically negligible, the Patent Office is always looked to for a profit. The Government pays for every conceivable kind of research and investigation and propaganda; but patents, on which our whole industrial system is founded, pay for themselves and pay a profit. We have not space here to discuss this point more fully; we return to it on our editorial page.*—THE EDITOR.

## Recent Patents on Mixed Fuels

AN investigation into the subject of recent patents granted for inventions relating to mixed fuels for internal combustion engines for automobiles and so forth has been made by a Dr. W. R. Ormandy and published as an article in the official organ of the Institution of Petroleum Technologists. The author thinks that an alarming situation has arisen owing to the number of patents now existing, in which there is no real novelty, sometimes even no useful feature, in the invention claimed or in which the "invention" resides in a combination of materials having such well-known properties as to render its feasibility at once obvious to any person having some knowledge of these matters.

The paper refers to the enormous increase in the numbers of installations having internal-combustion engines requiring liquid fuel. A parallel to the present fuel situation is provided by the case of rubber, until the production of plantation rubber was seriously undertaken, and by the existing shortage of the long staple cotton required by the tire industry.

The increasing prices of the liquid fuels required by the motor industry led the author to examine the patent specifications, bearing on this subject, from 1913 onward, to see what evidence there was of an awakened interest in volatile fuels. The specifications bear evidence of the universal assumption that alcohol in some form will be a constituent of the motor fuel of the future. A number of specifications are described in detail. The inventions chiefly consist in the admixture of crude or other alcohol with the well-known volatile hydrocarbons of the paraffin series, known under the generic term "petrol." From one specification it may be gathered that in 1870 it was common knowledge that commercial alcohol containing 5 to 10 per cent of water could be caused to mix with paraffins and similar hydrocarbons in the presence of fusel oil or higher alcohols. Sometimes a "mixing or combining agent," such as fusel oil or amyl alcohol, is added to avoid non-miscibility due to the water present in the commercial alcohol.

A second group of patents has reference to methods of increasing the vapor-tension of alcohol, which is low, especially in cold weather, by the addition of ether, alone or in combination with alcohol and other substances. A third group comprises the addition or admixture of gases, such as hydrogen, the lighter hydrocarbons of the paraffin series or acetylene, to the hydrocarbons of low volatility, so as to lower their ignition temperatures. Sometimes ether, alcohol, or acetone is added to increase the solubility of the acetylene. One specification claims the use of alcohol saturated with acetylene; another the same mixture with the addition of 1 per cent of acrolein as a denaturant.

Thus it appears that patents have been granted for admixtures of bodies, which every chemist knows will mix, and every engineer knows will drive an internal-combustion engine. Such mixtures are, moreover, of obvious application, provided that the ingredients are obtainable at a reasonable price. Many patents have been granted, and, no doubt, many more will be granted for inventions which are matters of common knowledge, presumably because the patent records of the previous fifty years cannot show that anything of the sort has been previously patented. Such patents would not be granted in Germany. Under the amended Patent Act in this country, it is possible to oppose the grant of patents on the ground of the prior publication of the invention in a technical paper, document or foreign specification. The indiscriminate granting of patents for every conceivable mixture of inflammable organic liquids, which might possibly be used as a motor fuel, constitutes a distinct danger to the motor user, motor manufacturer and community alike.

## The Influence of Cadmium on the Properties of Brass

CADMIUM possesses an influence upon properties of zinc and its alloys which may become injurious in certain amounts. A French investigator, M. Leon Guillet, has undertaken to determine the exact quality of this influence with respect to alloys of copper and zinc, and has published his conclusions in *La Revue de Métallurgie* (Paris).

Test pieces were taken from two series of alloys, one containing 70 per cent of copper and the other 60 per cent, the content of cadmium varying from 0 to 4 per cent. These were subjected to mechanical tests, traction, shock, hardness, etc. The following conclusions were arrived at: one per cent of cadmium in brass containing from 60 to 70 per cent of copper does not alter the mechanical properties. Since this percentage is never attained in these alloys constructors need have no fear of them. Examination under the microscope shows that these alloys have the normal structure of brasses and contain no free cadmium. When cadmium is present in more than one per cent the microscope reveals an increasing quantity of free cadmium. The cadmium is separated into filaments which have a tendency to surround the grains of the metal, and when the content becomes very high it forms spherical agglomerations recalling those made by lead in brasses. When this free cadmium appears there is a perceptible diminution in the chemical properties of the alloys.

The influence of the cadmium affects chiefly the resilience which undergoes an abrupt fall, whereas the other properties, especially those concerned in the traction test retain their high value. With a higher content of cadmium the elongations are lessened and soon reach a very low value.

## Filtering by Means of Spun Glass

IN the Gulf Coast oil fields much trouble is experienced with the working barrels being cut to pieces by sharp and exceedingly fine sand, to say nothing of the annoyances caused by the tubing becoming filled to such an extent as entirely to block the rods.

Experiments have demonstrated the value of spun glass as a filtering medium. A strainer was made of pipe of two different sizes, the space between having been loosely packed with glass, and brown settlings and sludges from a Bayonne oil plant used as a test. The finest particles of foreign matter were filtered out, the process also increasing the most minute water globules to the size of a pea, making dehydration much more readily accomplished.

Glass is non-corrosive, its hardness approaches that of sand, and even the finest threads are of sufficient strength to span half-inch openings in a strainer. It can be easily cleaned with gasoline. During the experiments with this strainer, which showed the tendency of the glass to enlarge water globules, another apparatus was tried. A two-inch glass tube was filled with one-eighth-inch glass rods running longitudinally, and the brown settlings were pumped through from end to end. Microscopic water globules were found to increase in size to "slugs" of a teaspoonful, due to the difference in viscosity of the two liquids. It remains only to initiate experiments under working-scale conditions to demonstrate the commercial application of the invention.

# Correspondence

**The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.**

## The Rule of the Road

To the Editor of the SCIENTIFIC AMERICAN:

I was interested in your note in the issue of the SCIENTIFIC AMERICAN of October 23rd, dealing with the change of road rule lately adopted by British Columbia. It was obviously inconvenient and unconducive to four horses were harnessed without a postillion to the left when elsewhere in the Dominion and in the United States the opposite is the practice.

At the same time the balance of argument, I venture to think, is in favor of the English method. The latter originated no doubt in the old coaching days when four horses were harnessed without a postillion to the vehicle. Much deftness on the part of the coachman was required to manipulate the long lash of the four-in-hand whip. It never was easy to give a touch to one of the leaders when it required it, but to do so from the left of the box seat would have been an action not only of extreme difficulty to the coachman but of considerable discomfort to his neighbors. The driver would naturally therefore adopt that rule of the road which permitted him at once to keep his right arm free and to judge best his distance from the wheels of oncoming traffic. This point obtains in a lesser degree today in the case of signals given with the whip to following traffic by the driver of, say, a two-horse van.

Again, it is the universal practice for a man when leading on foot a horse to do so with the right hand. Where the rule of the road is to keep to the right it is obviously dangerous to him. In this case he has to walk nearer to the middle of the road than his animal which, if restive, would very likely tend to push him still farther into the way of fast-traveling traffic. The contrary is the result under the English custom.

As to motor cars, it is, I believe, the general impression that it is easier to deflect to the left than to the right. If this is so safety needs no further argument.

So far as I can see there is only one argument in favor of the "keep to the right" rule. I admit, however, that it has cogency. It is that foot passengers keep to the right on the sidewalk. Under the "keep to the left" rule of the road when they step off the path they do so with their backs to the stream of traffic, and the danger for them, therefore, is greater. The question is then, which of the two methods has the greater recommendation. It is pardonable perhaps that I should allow this to the English practice.

MAJOR C. WARD JACKSON.

House of Commons, London.

[*The suggestion that an automobile turns more easily to the left is a new one so far as we are concerned. It would seem to us that the turn is easier when the driver is on the same side with passing traffic, with the curb or edge of the road on the other side of the car, just as in straight driving. We should think that so far as the motor is concerned, preference for the right-hand or the left-hand rule of the road is entirely a matter of right-hand or left-hand drive. Certainly our rule of the road is the reason for the left-hand drive in such a preponderance of American cars. This makes the matter adjustable, so far as the motorist is concerned.*—THE EDITOR.]

## Specimens for Exchange

To the Editor of the SCIENTIFIC AMERICAN:

We are members of the Natural History Society of our school and we should like to begin an exchange of specimens with some of your American readers. Several other members of this society would probably also like to exchange specimens from their various geological, entomological, ornothological or botanical collections.

If any of your readers who wish to exchange specimens will write to us at the below-mentioned address we will do our best for them.

Ackworth School, Ackworth, No. Pontefract Yorks, England.

W. R. SANDY,
W. S. LEAN.

## Motor Trucks and Country Bridges

To the Editor of the SCIENTIFIC AMERICAN:

In regard to your editorial under the above title: We have been getting excellent results on country bridges by changing our flooring from right angles to transportation, to parallel, and find it cuts down impact and vibration to a considerable degree.

It is also more economical as to replacements, as only the tread planks need renewal.

Lenora, Kan. J. C. BECKER.

## Edison and Life

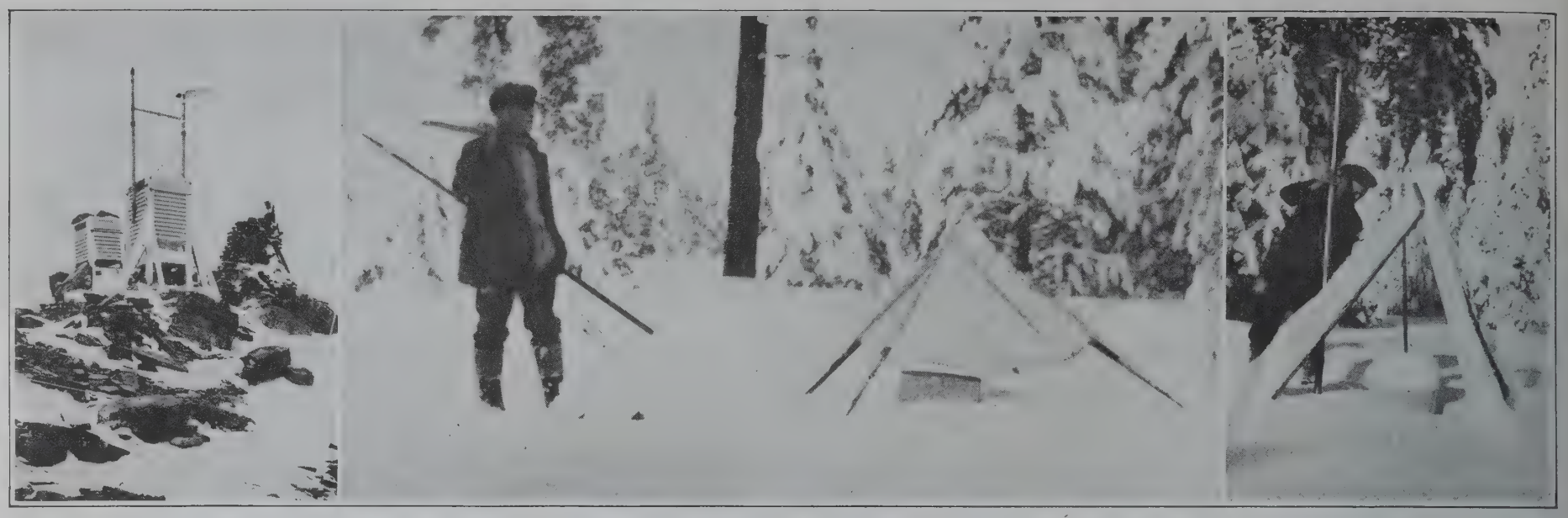
To the Editor of the SCIENTIFIC AMERICAN:

I have read in your number of October 30th the interview with Mr. Edison concerning his theory of the nature of life. It seems to me extraordinary that this great inventor and practical scientist could have indulged in such a futile and inconclusive process of reasoning. The problem is to account for conscious subjectivity (or personality) in man and to discover whether this conscious subjectivity persists or disappears. Mr. Edison's theory is that personality is merely the resultant of the joint action of myriads of hypothetical entities living in a community which disbands at the death of the organism they inhabit. These entities he endows (anthropomorphically) with human intelligence. Speaking of the restoration of the skin upon a burned thumb he says, "I firmly believe that the life entities rebuild that thumb with consummate care, drawing upon their remarkable memory for all details." In other words, he substitutes for the mystery of conscious subjectivity in man the equally insoluble mystery of conscious subjectivity in a theoretical being of infinitesimal dimensions. If Herbert Spencer were alive he would characterize this reasoning as "merely placing the problem a step further back."

The enigma of mind remains equally beyond the reach of our knowledge whether we think of it as appearing in man or in the far-fetched entities, which Mr. Edison supposes man to be composed of. Furthermore, it is of interest to inquire why, if the faculties of mind, as we know them in ourselves, are the ephemeral result of the community action of entities, these same faculties, as exhibited by the entities in the intelligent rebuilding of injured thumbs, should be immortal. Why are not the entities themselves mere communities of still more infinitesimal entities?

This incursion of our world-famous inventor into the philosophical field does not seem to have been felicitous.

New York. H. G. S. NOBLE.



*Left:* A snow-survey observatory on Mount Rose, 10,800 feet up. *Center:* Snow-survey station at Lake Tahoe, showing hood to protect instruments from current snowfall. *Right:* Snow surveyor removing his snow-filled sampler from the snow

**Measuring a year's crop of snow in the California and Nevada mountains**

# Surveying America's Snows

## How California and Nevada Forecast the Amount of Power and Water That They May Expect Each Year

By James Anderson

ONCE more the eyes of the world, or at least every section of the globe where heavy snowfalls are of periodical occurrence, are focused on the United States. For this country has taken one more step forward in the world of science. Realizing that probably the greatest stock of potential energy, greater perhaps than that of water, the snow in the mountains, was unmeasured and its moods not fully understood, the State of California has joined hands with Nevada and the United States Weather Bureau in a survey of the snow in the Sierra Nevada Mountains in an effort to forecast the stream flow in the two States. The progress of the movement will no doubt be a vital factor in the industrial and agricultural pursuits of those sections of the world where heavy winter snowfalls are of annual occurrence.

When these surveys have become general and results have been carefully tabulated and regularly published it will be possible for farmers to determine accurately in the early spring the exact amount of water they can depend upon during the summer months or growing season for irrigation purposes and they can thus plant their crops accordingly. Manufacturers depending upon water power to run their plants will also be able to figure how they will come out in this respect even during the dryest seasons.

Although pastiming in the white mantle of nature is considered primarily a winter sport, the business of snow surveying is indulged in during the spring and early summer months. A comprehensive plan has been developed to study the mountains of California and Nevada as one great system. Two quadrangles have already been formed consisting of the Central Sierra and Northern Nevada watersheds. Two more will soon be formed, consisting of the Southern Sierra and Northern Sierra Quadrangles. How large these quadrangles are can be estimated from the fact that the Central Sierra Quadrangle includes the Yuba, American, Mokelumne, Stanislaus, and Tuolumne Basins on the west slope with the Tahoe, Carson, and Walker Basins on the east.

Eastern and western outposts to the crest stations will be established in every basin to determine oscillation in the snow cover. The monthly increase of the snow cover and the probable demands will be determined by surveys at key stations each month throughout the winter, while a comprehensive survey will be made in April and May to determine the summer flow.

The origin of this new industry is peculiarly interesting. During the winter months both the faculty and student body of the University of Nevada for years derived a great deal of pleasure and sport from trips to the highest snow-clad peaks of the surrounding mountains. Dr. J. E. Church, Jr., was regarded as one of the leaders in these pleasure excursions. After innumerable trips into the winter Sierra his feeling changed from one of pleasure hunting to business. He remained longer than usual and started to investigate the snowfalls from a practical point of view.

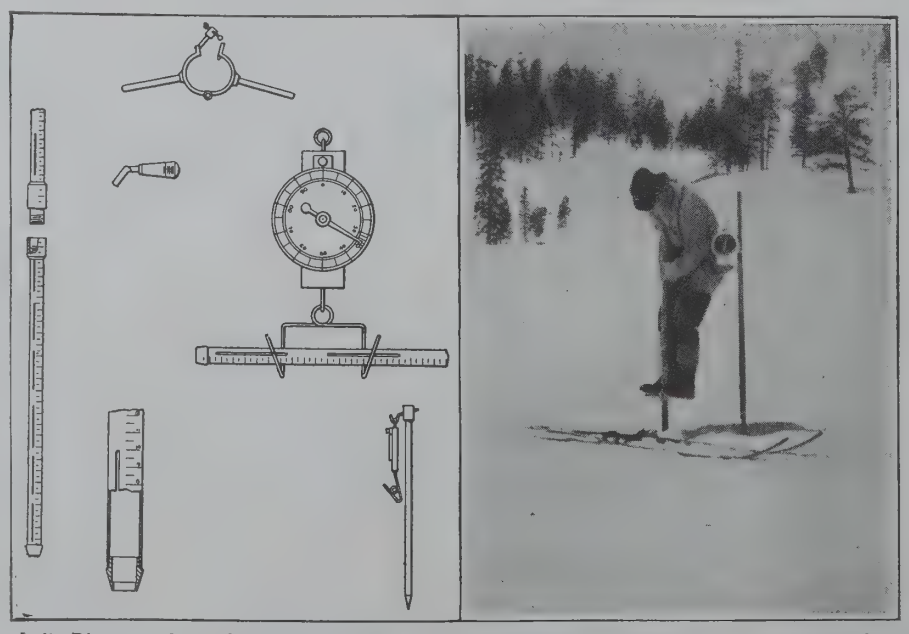
That was about ten years ago. He became so interested in his observations that on the summit of Mount Rose, which overlooks Lake Tahoe, and rises to a height of 10,800 feet above sea level, he established a mountain observatory and, in comradeship with a constantly changing series of faculty and student enthusiasts as the years passed by, gradually developed the method of snow surveying. This, in its simplest form, consists in determining the seasonal percentage of the winter snow cover of the high mountains and using the percentage thus gained as closely representative of the summer flow of the streams which are fed from this source of snow supply.

"Ten years have been spent at Mount Rose Observatory in developing our work," said Dr. Church in telling of this new science of snow surveying, "and many years more will be necessary under the coöperative plan to bring it to fullest service of the farmer and the manufacturer. The ultimate goal is to develop a despatchership of streams similar to the despatchership of trains on the great railway systems.

"After my years of observation I have found these surveys to be unfailing in their determinations of stream flow, allowing for a maximum of a twenty-five per cent shrinkage at times, which may be accounted for by lack of precipitation in April and May. Rain or snow falling in these months is conserved to a better advantage than that falling in June or July, for the obvious reason that during the latter months the moisture soaks into the soil of the mountains, and does not run off into the mountain streams. Shrinkage is one of the most vital problems related to stream forecasting.

"That there is a general relationship between the snow cover and the flow of the streams has long been known and attempts to correlate the two have long been made. Earliest, because of its simplicity, was the method of accumulated snow fall by which the depth of the snow was measured storm by storm. But the density of the newly fallen snow varied so greatly that even the average of a large number of snow falls occasionally caused seasonal distortions as high as thirty-five per cent between the estimate and the run-off."

Dr. Church then explained that the "percentage method" merely involves the searching out of representative areas in the high mountains where the snow lies level and unmelted from autumn to spring. Because of this fact late spring or early June is considered the best time of the year to do the work of surveying. Courses sufficiently long are laid out to assure an accurate average of the water content of the snow. The average of the annual measurements over a period of years is the standard from which are computed the seasonal percentages. The normal flow of the stream draining the basin is determined in a like manner from the stream measurements made by the U. S. Geological survey.



*Left:* Diagram of sampler and the dial that enables the surveyor to estimate the water equivalent of the snow it brings up. *Right:* Driving the sampler into a deep snow deposit

**Finding how much water will run out of a big basin from the snow that lies therein**

The instrument used in the surveys is a thin, steel tube so small in diameter that it can be extended by additional sections to a length of 20 feet without becoming too heavy to drive. A milled cutter and special adjustable wrench on which the surveyor can stand and thus become a human pile driver makes it possible to drive through snow however hard and deep. This sampler is now being used by the Swiss Glacier Commission to penetrate the upper layers of the Alpine glaciers and unlock the secrets of glacial growth. An aluminum spring balance with adjustable index, to eliminate the weight of the sampler, makes possible the immediate determination of the water content of the snow without computation.

The chief disturbing factor between the equilibrium of the estimates and the

(*Continued on page 603*)

## A Unit System of Freight Transportation

**By Charles N. Winter**

THE economic efficiency of the United States and of the world at large is being seriously hampered by the inadequacy of the transportation systems upon which the world's commerce depends. This is particularly true of the railroads of the United States but applies to the waterways as well. In both these branches of transportation, the terminal facilities are unequal to the constantly growing demands made upon them. The methods now employed to handle freight are for the most part so antiquated and slow that it is practically impossible to handle the business offered to them. A step toward relieving the situation appears to have been made by the use of the freight unit shown in the accompanying illustrations.

This unit consists of a rectangular container made of steel plate strongly reinforced with angle-irons and designed to be interchangeable between a truck, a railroad flat car, or a boat, thus linking the manufacturing plant with either rail or water transport, by means of the motor truck. It speeds up the handling of freight by loading it into a 2½-ton or a 10-ton container and moving the container with the contents undisturbed instead of handling a large number of smaller packages. This not only facilitates the transfer of merchandise, but as the container is both weather-proof and thief-proof, the loss so frequently incurred from those causes is eliminated. In addition, the manner in which the freight is packed in the container and the fact that the freight itself is handled only at the shipping point and at its destination, will prevent much of the damage occurring in train movement when goods are loaded loosely in a car or when less than carload shipments are transferred at junction points.

The complete equipment includes a specially constructed flat car which, however, differs from those now in use on the railroads of the United States only in providing a means of clamping the containers fast to the platform of the car. Engineering estimates place the cost of equipping a car with five 10-ton units at $1,000. The flat car may be constructed for the same cost as those in general use or an ordinary flat car may be altered to carry the containers at an approximate cost of $250.

This system was adopted by the United States Railroad Administration after an extended investigation of freight handling methods both in the United States and abroad. It was placed in operation and used successfully in inter-water-rail transport on the Warrior River in the New Orleans district for handling war supplies.

The containers used in that service are of 10-ton capacity and have side doors through which package freight is loaded or unloaded. Steel cables attached to lugs at the top corners of the container provide a means of lifting it from a truck and placing it on car or boat. To do this a crane or derrick or similar equipment is required. Such devices usually are available at manufacturing plants and in the larger freight yards and terminals but when, at small freight stations, such apparatus is not available the containers may be placed on a car and loaded in the sme way as an ordinary box car.

Another type of container is used for handling loose bulk material such as is generally carried in a gondola car. This type is constructed with top doors—and sometimes with a drop bottom—and can be loaded by hand or with material handling devices such as automatic buckets. This container is lifted by links attached to a spreader bar and engaging in slotted trunnions on the sides of the container. When the loaded container is in the desired position, the link latch is withdrawn and the container overturned, discharging the load or, when of the drop bottom design, the load is discharged through the bottom.

Other designs of this unit provide for refrigerator service; for the shipment of live stock; and tanks for liquid shipments. This system therefore is extremely flexible and any or all of the various classes of freight may be transported in small quantities on the same car with many of the advantages of carload shipments and none of the disadvantages of the present method of shipping less-than-carload freight.

Conservative estimates based on the performance of the new freight unit in government service indicate that the handling of freight may be greatly expedited by its use and that the cost of handling will be reduced to one-third or one-fourth of the cost of the older methods of handling the individual packages.

The advantages of this system are that it will unify the highways, the waterways and the railways; deliver freight from origin to destination without rehandling regardless of distance or number of transfers; protect freight from theft, contamination, or fire and water; increase the transportation mileage of motor truck equipment; permit the loading of freight before the arrival of the car; unload and release cars in from 1 to 2 hours instead of 12 to 24 hours, thus increasing freight car mileage; and convert a flat car into a box car or a gondola car as may be desired. Because of the great decrease in the time required for loading or unloading it will increase the capacity of terminals without any outlay except for the lifting apparatus. Its use should reduce joint river-and-rail rates, speed up river traffic, and relieve congestion at terminals.

**The St. Paul bridge that runs like an elevator and is operated like a street car**

## Applying Elevator Principles to the Railroad Bridge

**By Hjalmer Lindquist**

INSTEAD of swinging on a pivot or opening like a jackknife, a Minneapolis railroad bridge lifts itself up after the fashion of an elevator. The mobile section between the two towers is 96 feet long; its weight is 450 tons. This great mass is counterbalanced by two huge concrete weights, one at each end of the elevating section, together weighing nearly as much as the bridge section itself, so that two electric motors in the house on top can lift it with ease to the height of 55 feet in order to pass river traffic.

The concrete weights that slide up and down in the towers are each connected to the end of the movable section by 16 two-inch cables, eight on each side of the weights, passing over the large pulleys at the top of the steel towers. The signal control and lifting machinery is in the house on top of the bridge.

When a boat signals its desire to go under the bridge, the watchman turns on the electric current that operates the signal system and manipulates two levers controlling semaphores at either end of the bridge in order to warn all trains to stop. He must then wait a full minute before he can unlock the bridge section from its two ends. This is accomplished by pushing a lever. Switches are simultaneously operated as to derail any train attempting to pass the danger signals.

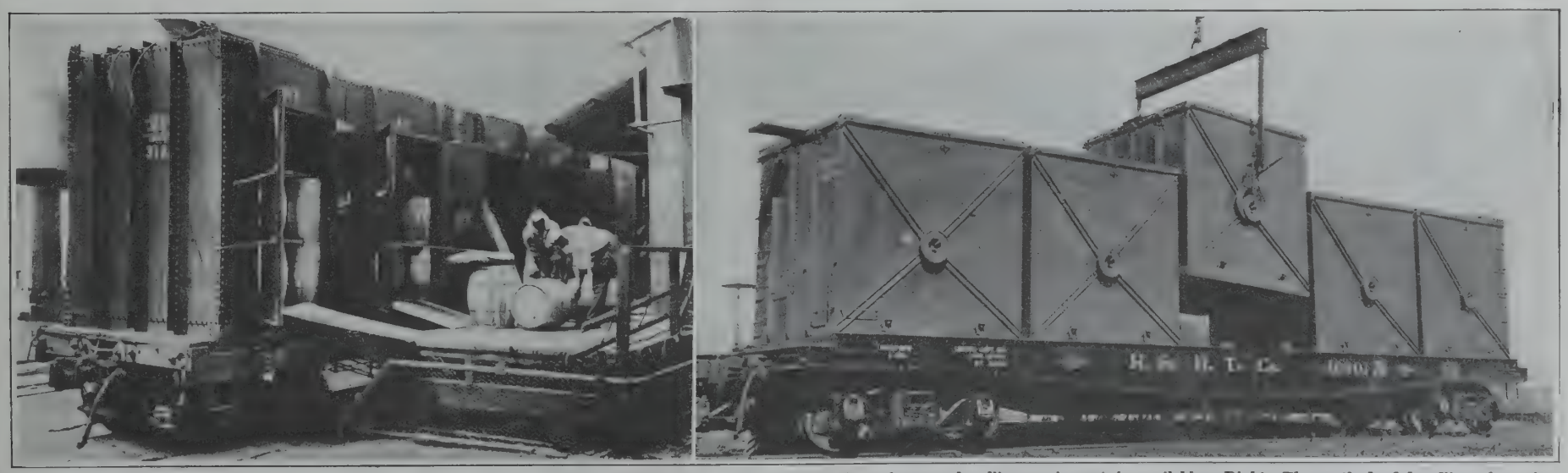
With the trains blocked at both ends of the bridge, the operator now unlocks the section, steps to the control drum, and gradually applies the current which operates the lifting motors. This control drum has much in common with the street car controller; in fact, the entire operation of lifting the bridge follows the manner of running an electric car. To raise the bridge the current is turned on and increased gradually. Going down, the reverse lever is first pushed into position and the power is gradually applied.

Signal lights on both sides of the bridge at night indicate to boat pilots when it is safe to pass under the raised bridge. A ball signal on top of the station, which may be raised and lowered, is used in daytime.

On the wall and rising from the floor of the control house are indicators that give the operator all the information he needs, making it unnecessary for him to look out the windows. Indicators tell the bridge operator if there are trains standing on the approaches and on what tracks they happen to be. A machine rising from the floor tells him to the fraction of an inch just how high his section is from its bottom or resting position. The operator cannot see at night how things are on the outside and no chances are taken of his making a mistake through the day.

A worm screw, about two feet long, is timed to trip a lever and break the circuit at both ends when the bridge section has come within three feet of the top or bottom of its travel. This device also makes for safety by stopping this machinery; it warns the operator to look at his indicator. To start it again he has only to press a button on the drum.

The average time to bring the bridge to the top of its 55-foot way is one minute; it can be done in half that time. The downward speed is the same.



*Left:* Ten-ton freight unit containers, locked on an ordinary flat car, being loaded at a small freight station where no handling equipment is available. *Right:* The method of handling the units at a large station

**Bulk and small-package freight in handy standard containers that stay with their contents to the ultimate destination**

# Wanted: An Inexpensive House

## A Review of the Building Situation and a Few Timely Suggestions

By Harry A. Mount

THE present housing situation, viewed through a pair of horn-rimmed spectacles over a mahogany committee table, presents an unusually knotty problem. But viewed through the eyes of the man who, with his household goods in storage and his family in a hotel, watches his savings account melt away while he searches frantically for a "permanent location," the whole matter is taken out of the category of problems and heads the list of pressing necessities.

Many thousands of persons have viewed the housing problem from this angle in the past three years. Those who have not solved it in a makeshift way have sooner or later come to consider how they might own their homes, with a limited cash outlay.

Everywhere in the building industry just now one is impressed with the fact that this a poor time to build a home. The cost of materials and labor is such that experienced builders have almost ceased operations. Such building as is going on is under the press of necessity or is being done by realty speculators who hope to dispose of their houses at a large profit before the housing shortage can be relieved.

Now as a result of this cessation of building there is already noticeable a considerable downward trend in the price of building materials. Men who have studied the situation emphasize the fact that thousands of persons who have bought homes of their own on the partial payment plan have taken upon themselves a bigger financial burden than they will be able to carry on a falling market. One large manufacturer of ready-cut houses made the frank prediction to the writer that within two years hundreds of these houses built for speculation would be upon the market at very reasonable prices.

A man need not go deeply into present building conditions to discover that it it is neither possible nor desirable to engage in ordinary building operations at this time on a moderate income. But as to the desirability of building now, the foregoing fact can be overlooked when building is a necessity. Then, too, there are ways to economize in building a small residence to bring the cost within average means, and that is the subject of the following lines.

First of all, let us admit that if the home-builder has a little mechanical ability and is able to wield a hammer and saw, the problem is much simpler. Now then, we must begin by acquiring a bit of land—a lot, if you please.

Once the lot is clear of indebtedness a building loan can usually be negotiated. Building and loan associations are organized for this purpose. Some of them, however loan only to bonafide home builders and refuse loans to realty speculators. Such firms are likely to treat the builder with far greater consideration than might be had elsewhere. One New York concern employs investigators who, when payments on a loan begin to fall in arrears, discover whether or not there is a real reason, and whenever possible arrangements are made to tide the borrower over a temporary financial stringency. Thousands of other firms are just as considerate in making loans to home-builders.

One of the first considerations in laying plans for a small home should be the local building restrictions. When possible a copy of the local building code should be secured and carefully studied. If much of the work is to be done by the builder himself a preliminary study of the code may save him costly rebuilding and a possible fine later, should a building inspector suddenly appear on the scene.

It is far safer, when one intends to do part of the work, to secure the advice and assistance of an experienced carpenter from the very beginning. The whole job will proceed faster and at less expense under his direction.

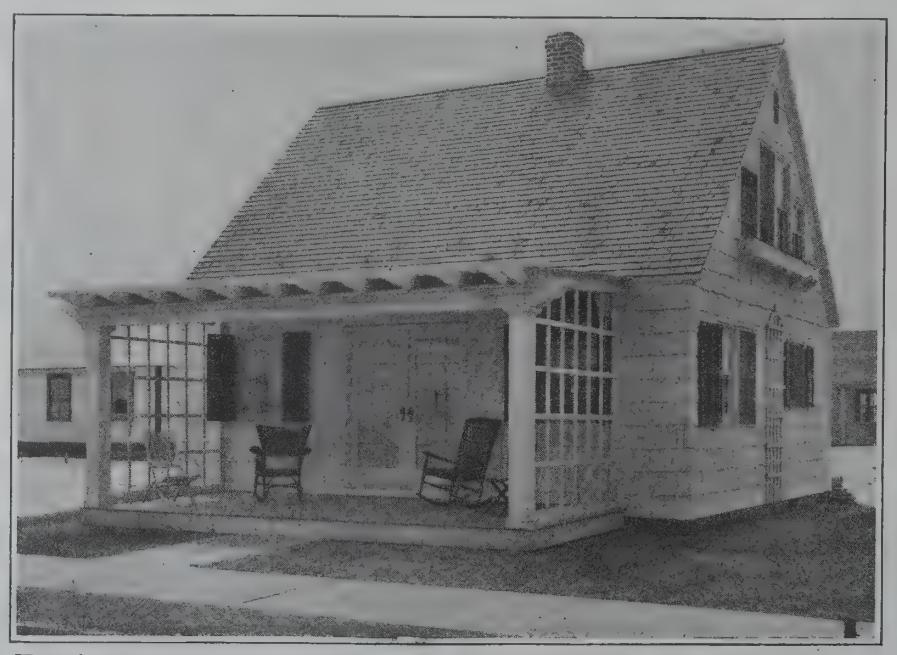
Another precaution to be observed is this: do not buy your lumber and materials at the nearest lumberyard without asking prices elsewhere. At times there is a sharp difference in prices even at nearby lumberyards, especially under present abnormal conditions.

Under very favorable conditions, and provided a part of the labor is done by the builder, a three or four-room cottage can be built for as little as $1,500. This figure contemplates a very small house of rather severe architecture, but well built and sealed so that it would be suitable for winter use. Let us have no illusion regarding a $1,500 house.

It would have no cellar; it would be roofed with composition shingles, and plaster board or wall board would be used on the walls. On each of these items there is a great saving in labor over standard practise.

If one has sufficient spare time, or can spend the days of one's vacation solving the housing problem for once and all, even the services of the carpenter can safely be dispensed with if one of the various types of fabricated houses now on the market is purchased. The lumber for these houses is delivered from the factory ready cut. Complete instructions accompany the materials and any man who can drive a nail straight can put them together. In some types the lumber comes made up into sections and these have simply to be nailed or bolted together.

*IT was altogether to be expected that the Editors of the* SCIENTIFIC AMERICAN *should be appealed to for aid with regard to the housing shortage. Here and there large plant executives and municipal authorities have asked for guidance in the matter of building homes for workers whose means called for inexpensive houses. And these appeals were answered by mail—answered individually and personally so as to take care of the peculiar requirements of each. All of which prompted us to formulate an interesting little problem in building, namely: Can a house be built for $1,000, and how? Mr. Mount, one of our regular correspondents, has attempted to solve the problem in the accompanying account. He sets the lowest limit at $1,500 for a very modest house, and gives a number of suggestions for inexpensive building operations. But our problem remains unsolved! Can any of our readers solve the $1,000-house problem?*—THE EDITOR.



**Here is a typical ready-cut house which is assembled by means of bolts in a minimum of time. The cost is about $6,000.**

The manufacturer of ready-cut houses has already taken care of the details such as design, compliance with building codes, selection of proper materials, etc. Because these houses are produced in quantity in a well equipped factory, the labor cost on the work already done when the lumber is delivered is obviously considerably less than if it were done on the job. The services of the architect who has designed such a house would be beyond the reach of the average home-builder; and the assurance that the architecture is correct is most comforting, even though the house be a modest one.

Buildings of the ready-cut type range from lightly-built summer houses of three or four rooms to eight- or nine-room houses, running in price from a few hundred dollars to $15,000 or more. The home shown in the accompanying photograph is the most popular model of a highly popular line of fabricated houses. It contains five rooms, ideally arranged for the small family. The cost, complete with foundation, plumbing and lighting equipment, ready for occupancy, is about $6,000. The cost of the bare house is $4,500 at the factory.

In this type of house, the material is made up into three-foot sections at the factory and the whole house is put together without nails—excepting in the walls—bolts being used throughout. Even the shingles are put on at the factory; it is only necessary to slip under a few lap shingles after the sections are in place, to complete the exterior. The idea must not be gained, however, that the construction is flimsy. On the other hand the finished house is of extraordinarily sturdy construction and will pass the most rigid building inspection. The walls inside are finished with plaster board and the house is said to be very cozy for winter use. The factory equipment for the house includes such details as hardware and bricks for the fireplace and flue.

Although the house has five spacious rooms, it occupies only 768 square feet of ground. From the front porch we step directly into the combination living and dining room, through double French casement doors. This room extends across the entire front of the house and a large fireplace in the center adds to its coziness.

In the rear of the ground floor are the kitchen, bath, a bedroom and the stairway to the upper floor. Above we find two cheerful bedrooms. The upper rooms are so constructed that very little of the roof touches them, giving good insulation from outside temperatures. The waste space under the roof is utilized in providing an abundance of closet space.

There is little hope of escaping high costs by the use of material other than lumber. Stone, brick, or cement construction, even though materials may be plentiful and at hand, require expert labor and the final costs are usually much higher than those for lumber. Certain types of molded cement construction, however, compare favorably with wood in cost. One of the most successful of these utilizes a double wall construction, with a dead air space between so that the house is suitable for use in climates where extreme temperatures are encountered. The walls are built by the use of a single mold, about three feet long and a foot deep. This consists of four steel plates held parallel by steel braces at the top. The plates are adjustable so that thickness of the walls and air space can be varied at will.

Concrete is mixed with only a small amount of water and is then tamped into the mold, directly on top of the foundation. Without waiting for the concrete to set, the mold is moved along the wall and another section tamped in. When a complete layer of the wall is thus built up, another tier is begun on top of it and the process continues round and round until the house is finished. The interior walls are of a single thickness of concrete and the whole construction is locked firmly together by the use of special tie-rods which are molded into the concrete.

The windows and doors in this kind of construction are set in place and the walls built around them. A stucco finish is usually applied to the outside and the plaster is applied direct to the inside walls. Cleats, to which the rafters are nailed, are built into the walls.

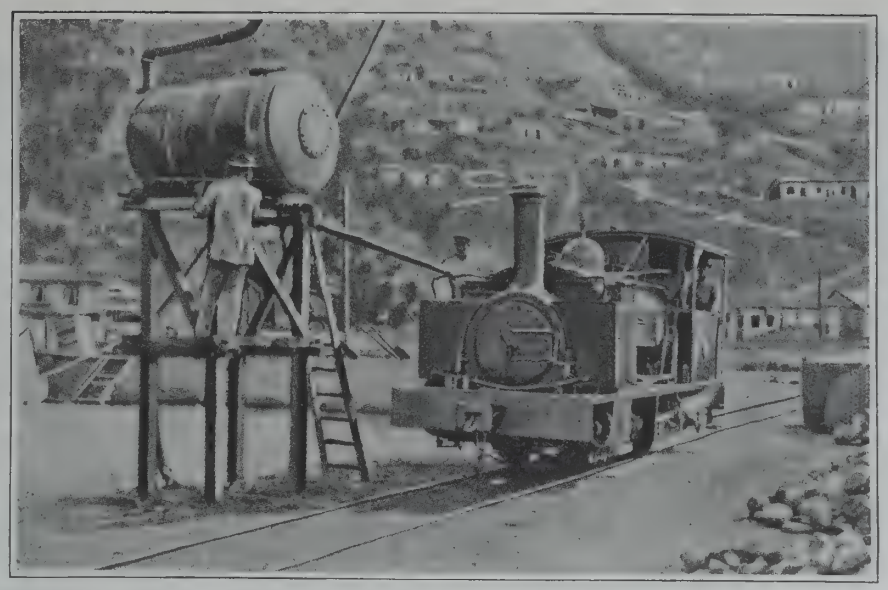
This concrete construction depends largely for success upon good workmanship, and the company which controls the patents sells the necessary apparatus

(*Continued on page 603*)

## Venezuela's Mountain-Climbing Oil-Burning Locomotives

**By Harry Chapin Plummer**

OIL-BURNING locomotives have lately supplanted coal engines on two of the steepest of trans-mountain railways in the Republic of Venezuela. The Minister of Public Works, Dr. Luis Vélez, reporting upon the success of the experiments with oil-burners, discloses comparative figures covering the running cost of trains over the 22.36-mile line on a 3.75 per cent grade and proves a saving of not less than sixty per cent in cost per train mile in favor of the new principle. The railway upon which the official experiments were conducted is the British-owned road operating between La Guaira, the chief seaport of Venezuela, and Caracas, the capital city. Hitherto the line has been operated at an annual cost per train kilometer (0.62137 miles) of 6.31 Bolivars ($1.26).



**Refilling the tank of a Venezuelan oil-burning locomotive employed over the mountain railroads**

The latest economy to be effected in the management and operation of the Caracas-La Guaira Railway bids fair to further its reputation for earning capacity. Within a quarter of a century the ratio (representing net revenue) of operating expenses to income was widened from Bs 1,972,282.46 ($385,656.49.1), the disbursement total for 1893, as against a gross revenue for that year of Bs 3,641,565.89 ($728,313.19.4), to Bs 965,232 ($193,044.20), the disbursement total for 1918, as against a gross revenue for that year of Bs 1,782,375 ($356,475).

Yet another of several British railways in the country, which represent an aggregate investment of Bs 89,485.500 ($17,897,200), has adopted the oil-burner.

The total railroad mileage of Venezuela today is 1,039 kilometers (645.37 miles). Three of the roads are State-owned, two are privately operated by Venezuelan companies and seven are under the control of English, German and French interests.

Minister Vélez, in reporting to the Venezuelan Congress upon the Caracas-La Guaira Railway observed:

"An instance of progress which we consider very important from the practical and economic point of view, introduced recently in the operation of some of our railways, is the use of national crude petroleum as a combustible for the locomotion of the trains. This practice has for us actually a double value—that of the traffic in a national product and that of our market coming under the influence of the universal crisis growing out of the war in the branch of combustibles. Five companies have commenced to introduce this improvement or to equip their respective hauling apparatus for the change in fuel."

Citing a test made on the heavy grade of the ascent from La Guaira to Caracas in two trips over the 22.36-mile run, in one feeding the locomotive with Cardiff coal bricks and in the other with crude petroleum, the comparative results are set forth as follows:

| | Trip in which Cardiff coal was used | Trip in which crude petroleum was used |
|---|---|---|
| Dead weight of train | 50 tons | 63 tons |
| Total consumption of combustible on each trip | 850 kgs. coal | 660 kgs. pet. |
| Consumption rate per ton and per kilometer | 0.47 " " | 0.29 " " |

"In order to make clearer our comparison," the report states, "suppose the two trains had been of equal weight, of fifty tons each, in that case the combustibles expended would have been, proportionally:

In the case of the coal, 850 kilograms
In the case of the crude petroleum, 524 kilograms

and taking into account that the prices which these combustibles have cost the railway company have been, in the port of La Guaira:

1 ton of Cardiff coal briquets Bs 124 ($24.80)
1 ton of crude petroleum.....Bs 74 ($14.80)

results in showing the cost of the necessary fuel in each trip to have been:

Employing Cardiff coal..Bs 106.75 ($21.35)
Employing crude petroleum Bs 38.78 ($7.75.3)

that is to say, that the use of crude petroleum develops an economy of more than sixty per cent—a very material economy, to be sure.

"From this result it is not difficult to present the following figures, experimentally obtained, as to the comparative properties of the two combustibles used in very thorough trials:

(*Continued on page 603*)

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**Three-quarter view of the new French airplane with the variable top wing for increasing the speed while in flight and slowing down for a landing**

Copyright, Kadel & Herbert

**Side view of the new variable-wing plane, showing the three members of the top wing almost entirely overlapped or closed**

## An Airplane with Variable Wing Surface Area

**By Alfred Longville**

THE idea of varying the area of the airplane wing while in flight is by no means new. As early as 1910 certain French designers conceived of airplane wings with airfoils that could be rolled up much after the fashion of the sails aboard a sail boat. The idea has always been to employ a wide expanse of wing surface while climbing to the proper altitude, and then reduce the wing surface in order to increase the horizontal speed. But the apparently successful execution of this idea is a matter of current event, and then only on an experimental scale.

No lesser aeronautical minds than Gastambide, Levavasseur, and Latham, the latter a cousin of the famous aviator of that name who was killed in Africa while on a hunting expedition, have evolved an airplane with wings of variable area. The new airplane, which is shown in two of the accompanying illustrations, is a one and one-half biplane, so to speak, for the reason that the lower wing is barely half as large as the top one. The machine is equipped with a 250-horse-power engine, driving a single tractor screw. The body is exceptionally thick yet properly streamlined to obtain the best aerodynamic results.

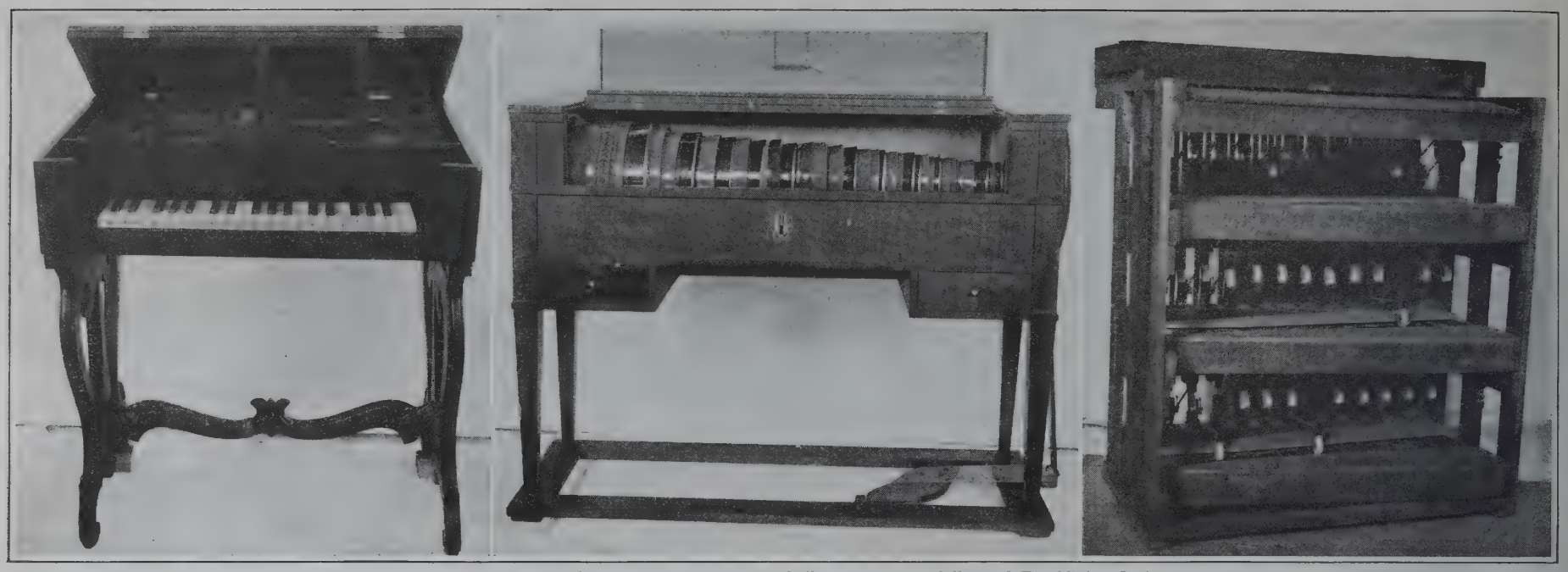
The novel feature of the airplane is the top wing, which, it will be noted by studying the accompanying illustrations, is the variable member. It consists of three sections, two of which, the top and the bottom one, slide more or less over and under the middle section which remains stationary. The narrowest width of the plane closed is 1 meter 60 centimeters (63 inches), while fully extended the plane is 3 meters 28 centimeters, (129 inches). The speed is given as 60 kilometers (37 miles) per hour, with full spread to 200 kilometers (124 miles) per hour, with the wing entirely closed, or a ratio of better than 1 to 3. The wing area is given as 52 square meters with wing fully extended, and 32 square meters with wing entirely closed.

The aviator Grandjean recently piloted the new machine at the flying field at Etampes, France, with excellent results, proving the practicability of the variable wing feature. For military purposes the machine has an immediate and invaluable use, since it can be slowed down for observation and photographing purposes, and speeded up at other times. For sport and commercial purposes, too, this variable speed feature is of prime imporance, since it makes for safer landings. All in all, the new airplane points the way to a new and safer era in aviation.

## Paper from Veneer Waste

IN the wood waste from veneer factories the U. S. Forest Products Laboratory sees considerable raw material suitable for the manufacture of high grades of paper. The cores of many kinds of veneer logs, now used in a large part for fuel, would make excellent pulpwood. In addition, a large part of the clippings could be turned into pulp stock with profit.

Among the veneer woods whose waste has paper-making possibilities are red gum, yellow poplar, cottonwood, birch, tupelo, basswood, and beech. Many veneer factories cutting these species are already within shipping distance of pulp mills. In certain other cases veneer factories are so grouped that they might furnish pulpwood enough to warrant the erection of a centrally-located mill. Other economic factors being favorable, such a mill could profitably operate on a daily supply of veneer waste equivalent to 50 cords of ordinary pulpwood.



*Left:* Flat glass rods in the case are struck as the keys are depressed. *Center:* A glass harmonica built on the general lines of Franklin's. *Right:* The glassichord of the early nineteenth century, showing mode of operation

**The glass harmonica and its near relatives are sometimes got up quite elaborately**

# Music from Glass

## Franklin's "Harmonica" and Other Instruments of the Same Class

By J. F. Springer

THE idea of getting musical sounds from drinking glasses or glass basins is at least as old as the middle of the seventeenth century. The finger would be moistened and the hollow glass vessels set into vibration by applying the finger thus prepared. Thus, in an old book printed at Nuremberg, directions were given how pleasing musical tones could be produced. Eight glasses of similar shape, and presumably equal size as well, are taken. Then, a spoonful of wine is put into the first, two spoonfuls into the second, and so on. Eight persons, each with wine-moistened fingers, are now to pass them over the several brims. It is said that there will be heard "a very merry wine-music, that the very ears will tingle." We have here what is apparently an inexact description of how to prepare a complete scale together with the octave of the key-note. Those who try it will doubtless find that the proper intervals from note to note are not so easily got as the description seems to indicate. Naturally, the wine will be no better than water in the various vessels. It was also suggested, in the same account, that a lesser number of glasses might be used and the arrangement be made "by order of intervals of thirds, fifths, and octaves, and, according to the size of the glasses, augment or diminish the wine."

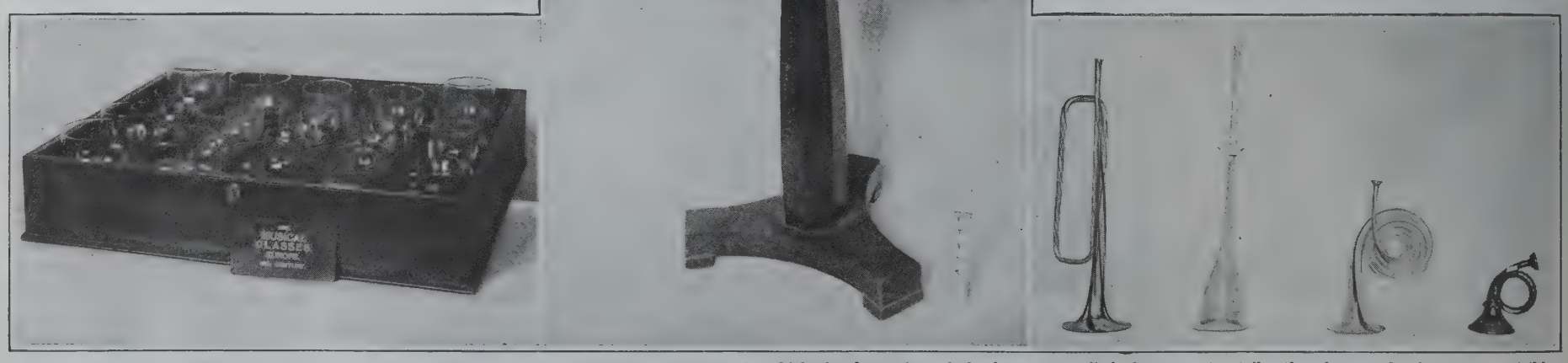
However, from this beginning, the famous *glass harmonica* may have been evolved, although Benjamin Franklin is nevertheless to be credited with its invention. But he himself attributes the first thought of playing tunes upon drinking glasses to a Mr. Puckeridge, a gentleman from Ireland. According to Franklin, Puckeridge actually grouped together a lot of glasses of different sizes and tuned them by putting in more or less water, as the case demanded. The instrument together with its maker and the house itself was unfortunately destroyed by fire. But a Mr. E. Delaval, a member of the Royal Society, imitated and apparently improved upon the earlier instrument. He gave particular attention to the form of the glass. This was the first instrument seen or heard by Franklin. He was delighted with the sweetness of the musical tones.

In Franklin's instrument, the seven notes corresponding to the natural scale were painted red, orange, yellow, green, blue, indigo, purple, and then the same succession of colors was given to the next octave. By this device, octaves were always of the same color. The five glasses representing the interspersed intermediate tones, which we usually assign on the piano to the black keys, he colored white. The player seated himself before the middle of the set, just as he would in seating himself at a piano or organ, and turned the glasses by a mechanical device operated by the foot. Every now and then they were to be freshly wetted with a sponge and clean water. "The fingers should be first a little soaked in water, and quite free from greasiness; a little fine chalk upon them is sometimes useful to make them catch the glass and bring out the tone more readily." Both hands could be employed, so that some attempt at harmony was possible. "Observe that the tones are best drawn out when the glasses turn *from* the end of the finger, not when they turn *to* them." Franklin's improved form of instrument dates from about 1762. There is, in the *Vicar of Wakefield*, an apparent reference to the novel instrument under the name of "musical glasses."

The instrument was used in exhibitions in France, Germany and Austria. The noted Italian poet, Metastasio, heard the instrument in Vienna and became enthusiastic. A certain Ferdinand Pohl, an artisan living in a Bohemian town, heard of the famous instrument, but appears to have had few details. He knew, however, that glass was the fundamental material. With this in mind, he thought that the glass bells used to protect clocks from dust could be utilized as means for producing the notes. His first instrument was at last finished, after much effort and neglect of ordinary duties, and he opened the door of his work-room to call his wife. Just then, a draft slammed the door with the result that a picture fell and ruined the instrument. Nevertheless, he went to work again, and this time with more lasting success. The Pohl form of instrument became celebrated throughout the world.

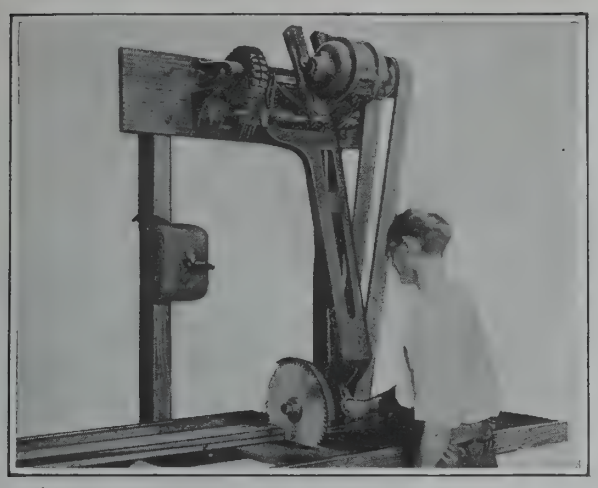
The glass harmonica has not become a permanent thing. There are probably a number of instruments—

*(Continued on page 604)*



*Left:* A set of musical glasses on exhibition in New York. *Center:* A keyboard instrument, in which the depression of the keys causes little hammers to strike the glasses; the former are visible but not the latter. *Right:* Nineteenth century glass horns producing a single note each

**Some unusual musical instruments of glass**



This swinging saw is so constructed that it cannot swing back and injure the operator

## Swinging the Saw to Cut the Wood

A CINCINNATI manufacturer has lately brought out a new type of swing saw which protects the operator by its new mechanism swinging the saw back automatically and away from the lumber being cut when the handle is released. This allows the operator to remove the cut lumber without the danger of the saw swinging back and cutting his arm or hands. The safety lock attachment keeps the arm from swinging forward unless the handle is pulled by the operator.

The saw is a self-contained unit and may be easily installed by hanging to any convenient wall or column and connecting motor to the nearest electric wires. A switch inserted on the saw frame makes it possible to turn off the current when the saw is not in use without leaving the work in hand.

The safety feature of the saw will make it particularly adaptable to the use of merchandising plant shipping departments where frequent changes of employees might result in serious accidents with the use of machines not equipped with the safety device.

## Paper Pulp in New Zealand

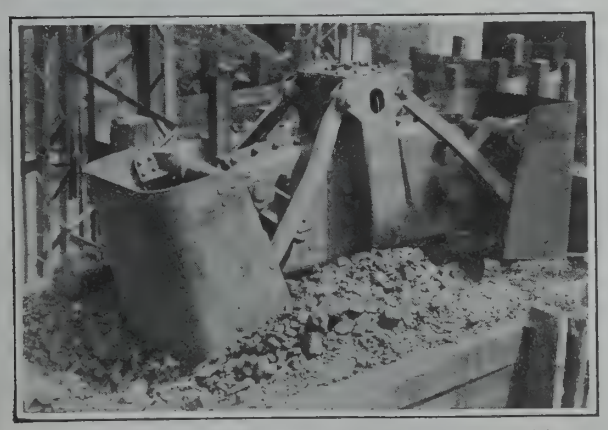
THE New Zealand Government has granted a lease of 30,000 acres of white pine land and also water rights for the generation of electric power to a company which intends to use the pine for paper-making, a purpose for which it is claimed as very suitable. At present all the newspaper used in Australasia comes from either Canada or Scandinavia and the pine has risen from under £20 to £80 a ton in the last few years.

## Enclosed Gears for the Clam-Shell Bucket

THE use of clam-shell buckets in handling bulky materials, such as coal, sand, gravel and cinders, has always been accompanied by expense and serious delays made necessary by the renewal of operating cables and chains. Ordinary clam-shell buckets are so constructed that a large quantity of the material handled comes into contact with the operating parts of the bucket. This results in excessive wear of the operating parts due to the abrasive action of the material.

Such faults have been eliminated by the clam-shell bucket developed recently by a Cleveland manufacturer. All of the working parts of this bucket are enclosed in a tight casing where they are constantly lubricated and where they do not come into contact with the material being handled by the bucket.

The bucket is made of a minimum number of parts which are arranged to facilitate the removal of any part in case of necessary repairs. The accompanying close-up view shows the bucket's simplicity.



A clam-shell bucket in which all the working parts are enclosed and protected

## Using Compressed Air to Reclaim Bolts

A BOLT-RECLAIMING device is the invention of H. U. Prindle of a Pacific coast shipbuilding company. It is destined to hasten the work of preparing bolts that have been once used, for further use. Customarily, this work is done by hand, it being necessary to work the nut off the bolt—generally this necessitates a hammer—and then to clean the threads. Frequently it is necessary to re-thread a bolt, or to make a smaller bolt from it, in order to use it all. The average number of bolts cleaned per day by hand, as against the number with a machine, varies in the proportion 198 to 1,000, over five times the number being accomplished with the machine.

This machine was built of scrap iron and steel. It consists of a receptacle for the nut—the round object in the center of the picture—which revolves in either direction, and a stationary slot for the bolt, to insure its being held straight. This is the slot seen just above the nut-receptacle. To reclaim a bolt, it is slipped in the machine and held by hand, while the receptacle for the nut is worked back and forth rapidly, a short distance at a time. This not only removes the nut, but also cleans the threads without injuring them and increases the efficiency of the nut from three times, as is the case with the hand method, to ten times or more with the machine. Four other similar machines are being built at this shipbuilding plant.

An air-operated bolt reclaiming device which expedites the cleaning of screw threads

## Iron and Steel in Australia

THE Australia output of iron and steel, at present comparatively small, will probably show a marked increase in the near future. The Broken Hill Proprietary Company is enlarging the capacity of its steelworks at Newcastle while the Queensland Government has decided to establish State steel and iron works at Bowen. It is estimated that these will cost between $10,000,000 and $15,000,000 and employ, when in full operation, about 4,000 men. In view of the adverse rate of exchange with the United States an effort will be made to secure the machinery entirely in Great Britain and Australia. While the works are not likely to be completed for three years it is hoped to begin production 12 months after the arrival of the machinery. Railway rails for the State lines will bulk large in the output. A group of Scottish ironmasters is trying to arrange to work the iron deposits at Yampi Sound in Western Australia where there is a hill of exceptionally pure iron ore immediately on the shore of a fine harbor. It is officially estimated that there are 97,000,000 tons of ore of very light purity in sight above water-level while the total quantity is probably much greater. It has been proposed that the melting works should be established in Portuguese Timor, 300 miles from Yampi Sound, where manganese and fluxing materials are available while coal could be obtained from Borneo. It is unlikely, however, that the Australian Government will allow the ore to be exported to Timor and there is an alternative proposal to have the works at Gladstone, in Queensland, where plenty of coal is available close to a good port. There is a rise and fall of tide ranging up to 38 feet at Yampi Sound and if the problem of securing electric energy from the tides could be solved smelting could be done very cheaply on the spot. There is also a probability of a big iron and steel industry being developed at Loraina in the island of Celebes, a port of the Netherlands Indies. This has a field within 18 miles of a port estimated to contain something like 200,000,000 tons of ore yielding 50 per cent of metallic iron, chrome iron, nickel and manganese.

A clothes sprinkler made of aluminum after the fashion of a salt shaker

## The Salt-Shaker Idea as a Clothes Sprinkler

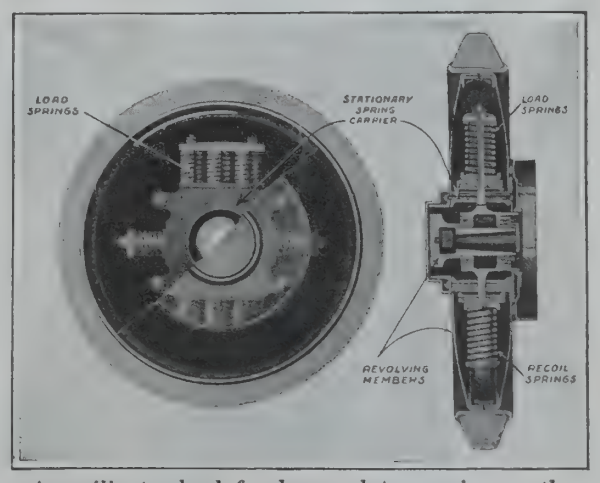
FOR the woman who still insists on doing some of her washing, a Bloomington, Ill., manufacturer of aluminum ware has brought out an aluminum clothes sprinkler. A screw top containing a large number of small needle-point holes affords an even spray of water. One filling of water should be sufficient for the average washing as it will hold a little more than a half pint of water.

## A Resilient Wheel for the Solid-Tired Truck

A NOVEL form of resilient wheel designed for heavy power vehicles, operate on a new principle, has been recently devised. As illustration shows, the wheel is not built on the same principle that most spring wheels are. In the design outlined the wheel is mounted on an axle member and secondary springs surround this axle. A frame on each axle end is permanently positioned and in this there are eight coil springs, three being carried above and three below, while there is one spring on the back and one at the front of this frame. The springs are so placed that there is a certain degree of tension on them which is claimed to make for steadiness of action.

The construction of the resilient wheel is such that the load is carried by the upper springs and the recoil of these members is absorbed by the lower springs. The wheel has two sets of parts, one being stationary at all times, and the other capable of revolving. The rotating series includes the wheel disks, tires, bearing inner races and the wheel driving members. The stationary series comprises the bearing outer race, the spider block springs, spring bolts, spring bridge and spring plates, and these parts always maintain their position because the spring carrying block is keyed to the shaft or shaft housing depending upon the design of the axle. The horizontal front spring is compressed only when the clutch is engaged while the horizontal rear spring is loaded only when the brakes are applied.

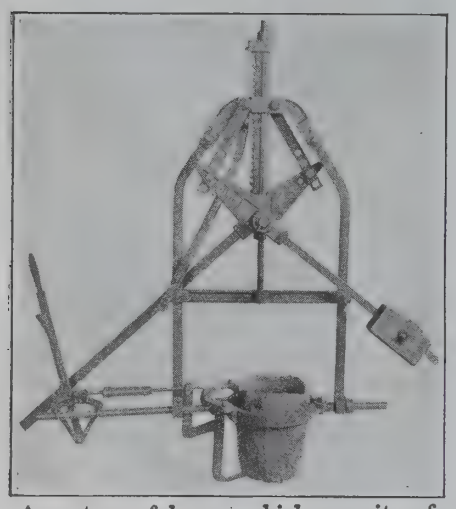
It is stated by the builders of the new wheel that the factor of safety is so large in this design that there is no possibility of the springs breaking as the carrying capacity is 100 per cent greater than the capacity of the main frame supporting springs. By the use of this floating hub construction, it is advanced that great ease of riding is obtained, that the usual form of solid rubber tire is satisfactory under all conditions and that higher speeds are possible without damaging the mechanism, than can be obtained with the usual form of non-resilient wheel.




A resilient wheel for heavy duty service on the largest of present-day motor trucks

# Inventions New and Interesting

*A Department Devoted to Pioneer Work in the Arts*



A system of levers which permits of one man handling a 400-pound ladle

## A One-Man Ladle for the Efficient Foundry

IN the average small foundry where molten metal in small quantities is poured into molds for making light weight castings, it is usually necessary to carry the metal to the molds in small ladles called bull or shank ladles. This involves the liability of spilling the metal causing injury to the workmen or loss of the metal or both.

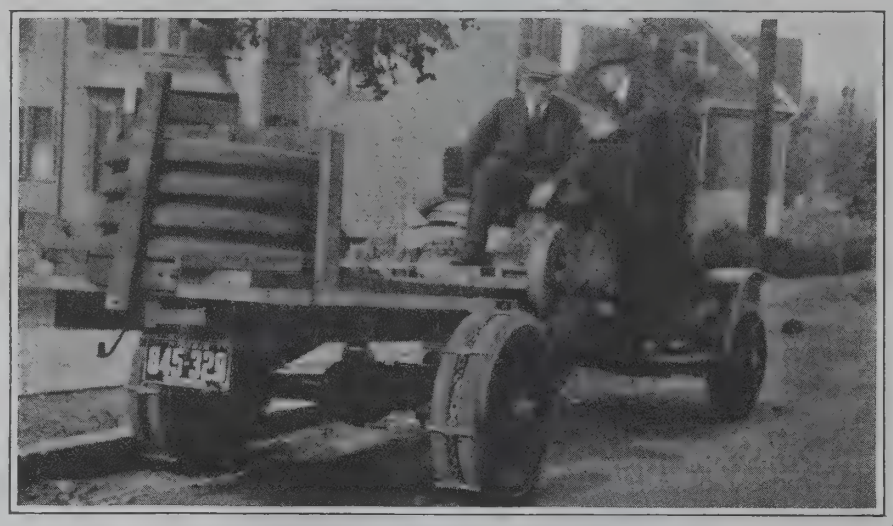
A new device, claimed to overcome these troubles and to represent the latest ideas, has been put in the market by a company of Detroit. The novel feature of the new device is that it is mechanical and is the product of scientific study. In foundries where these machines have been used, it is reported that they have quickly paid for themselves. One man, with this device, can pour almost three times as much as two with the old shank method and in less time, it is claimed. The pouring is more accurate with fewer spills and accidents, and with burns almost eliminated.

By means of a set of adjustable levers and a counterbalance a man gets mechanical advantage great enough to lift over 500 pounds. A ladle of 400 pounds capacity is easily lifted to a height of 18 inches, owing to the leverage.

The details of the mechanism for handling heavy ladles are shown in the accompanying illustration. The operating lever controlling the pouring of the ladle appears at the left, and the counterweight at the right.

## A Non-Skid Grip for the Motor Truck Wheels

IN the non-skid device being manufactured by a Connecticut factory, steel cross bars attached to electrically welded chains is one of the latest improvements for the motor truck using dual tires. The chain slips in between the tires and is locked tight. The steel cross bars overlapping the rubber of the tires are round on the tread of the tire. When coming in contact with sharp objects this round bar displaces the rubber passing over the object without damage to the tire or the bar. It is also claimed that the cross bars eliminate vibration.

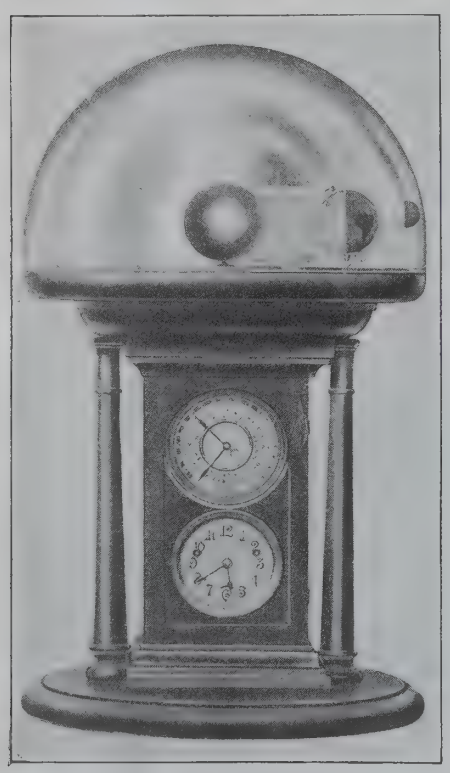


Experimental motor truck fitted with a new type of non-skid arrangement on the rear wheels

## The Life of a Tractor

THE amount of service which a tractor will perform before it must be replaced is obviously an important factor in determining its value for farm work. The United States Department of Agriculture has given serious study to this problem and while it cannot give any official figures that are definite as to the life of the tractor, it gives an average estimate of eight to ten years. Of course, the factors that influence the amount of service rendered by any given machine are, first and foremost, the care that it receives at the hands of the operator, then the quality of the outfit, the kind of work for which it is used, the service rendered by the organization that builds it and the skill with which it is designed and constructed. Nearly all tractors are used under conditions which are extremely severe for any kind of a machine. They travel over rough and uneven ground and work in an almost constant shower of dust and dirt, which is extremely hard on the wearing parts.

White, green, and red lights serve to indicate the speed of the automobile



An astronomical clock which shows the position of sun, earth and moon at a glance

## What Time Is It by the Sun, Earth and Moon?

WHAT is said to be an improved astronomical clock represents the ideas and unrelenting work of an ingenious Chicagoan, Michael Bulka. This clock, which is shown in the accompanying illustration, exemplifies and illustrates the movements of the earth and moon around the sun, with the moon swinging about the earth. These various movements, in concert with the actual happenings, typify the four seasons of the year.

In a glass dome surrounding the clock are three globes representing the sun, earth, and moon. This group shows how the sun illuminates the earth and moon; how the earth revolves around its axis every twenty-four hours, giving us both day and night; how the earth travels around the sun, giving us the four seasons of the year; how the moon revolves around the earth, thus changing its illuminated area; and how the earth and moon together revolve around the sun, giving us the twelve months in the year. The eclipse of the sun and moon, when they occur, are plainly depicted by the mechanism. The globes representing the sun and the moon have been coated with phosphorous preparation which radiates rays of light. The clock has two dials indicating time of the year and of the day.

## Colored Lights to Indicate the Speed of Cars

A SPEED indicator for motor vehicles "to be seen and read by all men" at a glance and that registers speed by the flash of colored lights, is the recent invention of Col. Charles Gore of Los Angeles.

The mechanism is encased in a metal box to be fastened to the front of the radiator. In the box or case are three large *eyes*, white, green and red, respectively. A regular speedometer cable connects the mechanism with the front wheels of the car, and when it begins to move the white light burns automatically.

This continues until the rate of travel passes the limit of the city ordinance, when the green light comes on, showing that the county rate is being used. If the driver exceeds that the red light flashes its signal of danger to all within seeing distance. Since the mechanism cannot be manipulated from within the car, it is impossible for the motorist to falsify his speed.

These lights lock automatically; hence if a driver breaks the city law for only a few minutes the green light will continue to burn after he has slowed down to the white range. By this means a traffic officer or any observer outside the car can tell by a glance what has been the rate of travel. In case of accident the lights burning will be conclusive evidence, registering either for or against him.

One who is an innocent victim of another's speed or a pedestrian's blunder will not be held up unnecessarily, causing vexatious delay, or, as is often the case, accused unjustly and convicted through mistaken or willfully lying witnesses. Likewise the guilty can be promptly dealt with, no time is lost, no confused witnesses summoned to court.

The city and county will also be saved much. Costly prosecution and wasted time are eliminated to the advantage of tax-payers. The immutable evidence of the mechanism means swift justice to all.

## Something New in Hose Clamps

ONCE every so often a photograph has been staged in such an ingenious manner that it tells its own story. Such a photograph, we believe, accompanies these few lines. It depicts a new type of hose clamp at the left, and the old-style hose clamp at the right. The new type, it will be noted, is operated without tool of any kind; it is merely necessary to place the ring about the hose, adjust the ring to fit, and then press home the lever member, as shown. The old-style clamp requires a screw-driver and a pair of pliers, as shown at the right.

Copyright, Keystone View Co.

The new and the old types of hose clamps and how to apply them

## The New Battleship "Indiana"

(*Continued from page 587*)

in together and united in a single structure as shown in our engraving. Although the arrangement looks very odd at first sight, it has the advantage of simplicity, and the even greater advantage that it removes the outflowing gases from the neighborhood of the navigating and fire-control positions that are clustered around the forward mast.

Immediately abaft No. 2 turret is the conning tower, which in these ships is built of enormous weight and strength, with an armor protection that will be proof against heavy shells at fighting ranges. The signal bridge surrounding the chart room and pilot house is extended around the top of the conning tower. A notable feature is the use of very long range-finders, 30 feet or more in length. These pass entirely through the turrets and have only their object glasses projecting on each side of the turrets. They are thus very effectively protected against shell fire. Attention is drawn also to the large number of searchlights provided, there being two on specially-prepared towers on each side of the smokestack, and a cluster of several at the first third of the height of the main mast. The complement of the "Indiana" will be about 1,500 officers and men.

## The World's Greatest Shipping Terminal?

(*Continued from page 590*)

330,000 gallons. The average daily consumption is 1,800,000 gallons.

The water system at Hog Island is sufficient to supply a town of 30,000 people. It is interesting to note that water is pumped from the Delaware River, filtered, used for domestic purposes, filtered again and returned to the river in better condition than it was taken out.

There is one sewage disposal plant: a surface drainage system of two pumping plants using two sewage drying beds and one disinfecting house. The sewage system would take care of a municipality of 30,000 people.

Much of the machinery used in ship construction, etc., is operated by compressed air, which is supplied from 7 compressor houses. The compressor equipment consists of 19 cross compound compressor units direct connected to high voltage synchronous electric motors. The total capacity of this compressed air system is 73,675 cubic feet of air per minute requiring 14,250 horse-power.

The work of constructing the various utilities was carried on under the greatest imaginable handicaps, both as to isolation of location from transportation, water supply, bad drainage, weather conditions, labor conditions, and other causes coincident with the construction of the shipyard being carried on at one and the same time. During the winter months ground was frozen to a depth of 2 feet, and a considerable portion of the excavation required blasting. It was also necessary to thaw the ground by means of steam at times in order to permit excavation.

The terminal facilities at Hog Island are of such a nature that they might be made of great value as another terminal for our eastern coast. In fact, from information gathered from one source or another, it appears that it could be easily made one of the world's greatest terminals and the city of Philadelphia and the state of Pennsylvania would do well to acquire this plant as a site for such a terminal. Hog Island is one of the marked exceptions, in the entire war program in this respect: that is, building will be entirely justified as a terminal, aside from its shipbuilding facilities. Hog Island today occupies the position of being as good a salt water terminal or coast terminal as any in the United States. The terminal exists; and if the United States government wants to commence using it to-morrow morning as a terminal it can do so.

Let us review a few facts in regard to this plant as a terminal. The 26 wooden warehouses and the large concrete warehouse were designed so that they would be available as storage houses in a terminal scheme. Each warehouse is served by a railroad track for the entire length of the house and each warehouse has a platform adjoining a street for its entire length. In other words, each warehouse is available for its entire length to the railroad, to teams and to tracks on opposite sides of the house. The 25 miles of railroad track serves the 148 acres of steel, machinery and outfitting storage yards, and was designed to be available for the storage of any material that could be stored in the open.

In designing the seven outfitting piers, two standard steam railroad tracks were placed on each side of the pier with double cross-overs between each two tracks about the center of the pier. These two tracks serve every ship at the wet-basin piers, which helps in the speed of outfitting ships, and is very desirable when the piers are used as commercial piers in that the track on the outside of the pier can be used for flat cars containing heavy, bulky material and the freight on that track is within reach of the ship's tackle. On the inside track can be placed box cars containing freight which must be unloaded on the pier, and freight unloaded from box cars on the water side of the track is within reach of the ship's tackle.

Each of the seven piers is equipped with four self-propelling gantry cranes running on a wide-gage railroad track, which spans the outside railroad track on each side of each pier. The clearance under this gantry crane is sufficient to permit the operation of standard locomotives and cars. Each of these gantry cranes is equipped with booms 50 to 70 feet in length. In addition, each of the piers is equipped with two self-propelled locomotive cranes, and pier B is equipped on each side with a bridge crane with a span of 118 feet and 111 feet clearance from mean low tide with a lifting capacity of 100 tons, which is used for placing the turbines and reduction gears in the ships immediately after they are launched. The same crane is admirable for placing locomotives and other heavy articles in the holds of vessels.

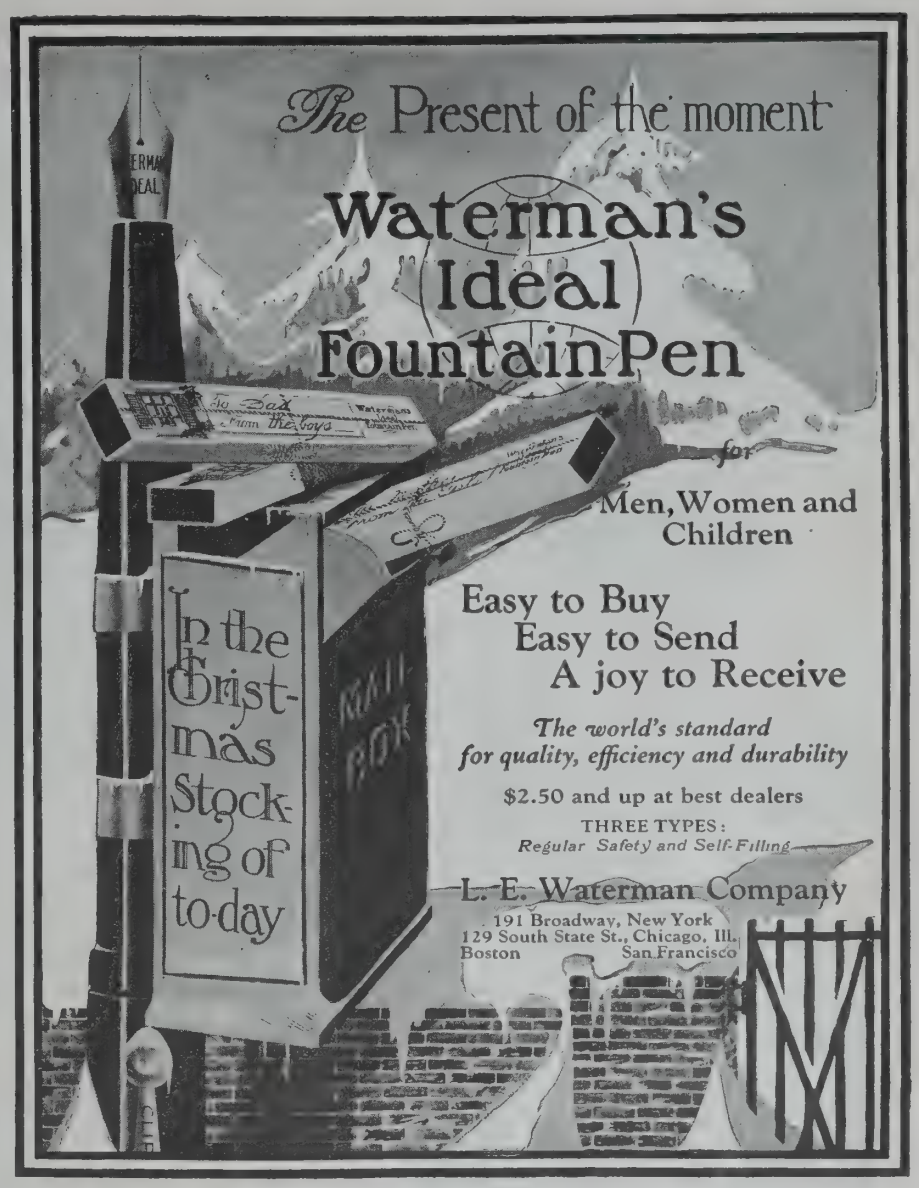
There do not exist at any commercial port in the United States any better equipped storage yards and storage houses or piers for commercial purposes. In fact, at no other commercial piers in the United States does there exist today 50 per cent of the modern appliances for the handling of cargo and the quick dispatch of vessels with economy and speed that are at this minute available at Hog Island with all details so thoroughly and painstakingly thought out and provided for.

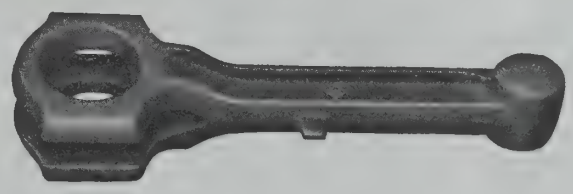
## From Wood to Cloth

(*Continued from page 591*)

minute splinters and particles by being held against grindstones. Strong paper is made from chemical pulp in which the fibers are separated by acid, as in the common sulfite process, or by alkalies, as in the soda and sulfate processes. The so-called "Kraft" paper, the term of Teutonic origin signifying strength, is made from undercooked, nonbleaching, brown pulp. This paper, true to its name, is remarkably strong and resistant to wear and is especially adapted for wrapping purposes.

The manufacture of paper textiles begins with a good grade of thin, tough paper of the Kraft type. This is cut by special machines into narrow ribbons from a sixteenth to half an inch in width, depending upon the size of the thread or yarn desired. The finest thread is made from a kind of tissue paper. These ribbons are rolled into flat, disk-like reels ready for spinning. If a white or light-colored yarn is wanted the paper used is

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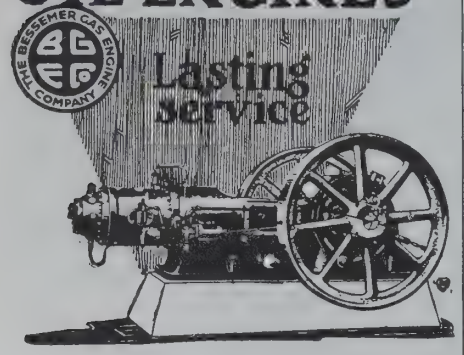


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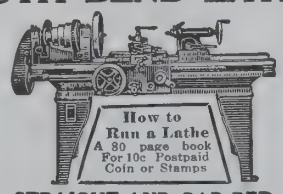


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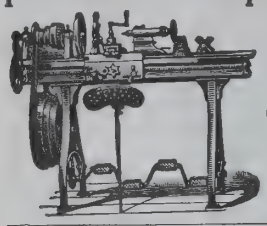

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made from bleached pulp. It is likely to be less strong.

The spinning is usually nothing more than the twisting tightly of a single paper ribbon. Such paper yarn breaks easily and with a short fracture. Sometimes several fine ribbons are spun together or several spun threads are twisted cable-like. Again an inner core of spun paper may be covered with the waste from other fibrous materials such as cotton and flax. The paper yarn may be "processed" to make it waterproof, though the efforts in this direction have not been entirely satisfactory. The best results have been obtained by the mixing of yarns and by tighter twisting of the paper.

There is nothing novel in the weaving process as the ordinary loom, bobbins and shuttles are used. Some textiles are woven entirely of paper yarn, others in mixture with cotton or nettle fiber. Pure paper textiles are rather stiff and coarse and are without nap. They are not suited for hard usage or wear and laundering must be done with extreme care, as wetting makes the "natural" paper cloth very tender. If such goods are to be exposed to the weather it is necessary to impregnate them with some water-proofing substance. The quality of the goods varies all the way from thin muslins and print cloths to heavy canvas and coarse matting.

That Germany found paper textiles of great help during the war is indicated by the wide range of uses to which the material was put. Among these may be mentioned, in addition to clothing, lining for gas masks, bed sheets and covers, straw mattress ticking, sand bags (mixed tissue), bread bags, cloths for wrapping feet (as worn by soldiers in place of socks), mull tissue for dressing wounds, sail canvas, uppers and inner soles of shoes, boot straps, belts, shoulder straps, galloons, braid, markers, insignia for prisoners of war, shoe laces, pack thread, twine and ropes. There were also many household uses such as matting and hall runners, table cloths and napkins, towels, wall covering, curtains, bed covers and sheets, pillow cases, lining and stiffening for clothing, and print goods for dresses and miscellaneous.

The manufacture of paper yarn was not due in the first place to the war, as long before that time, rugs, runners, curtains, wall hangings, twine and especially sacking were made from this material. The need produced by the war greatly stimulated and extended the use of such textiles. Along with the paper substitute for cotton might be mentioned nettle fiber, and the fibrous material of rush, broom and turf. Articles of apparel for men were made out of 25 per cent turf fiber and 75 per cent artificial wool.

Whether or not the paper textile industry has much of a future in store cannot be determined at present. Some of the German writers look upon it hopefully, and one speaks of the obvious significance of the discovery of the use of wood cellulose for "such purposes as sacking, roofing, binding, and for the materials for making pockets and the like." But scarcely for clothing.

## A Giant of Old

(*Continued from page 591*)

brought from a head race at a little distance, but on the opposite side to that on which the power was delivered to the main-shaft. The water passed through a head gate arranged in the race. This gate admitted to a 48-inch brick conduit that led to the wheel. It should be understood that the wheel was set with the one side next to the face of a ledge or terrace. Naturally, this was the side next the head race. From the brick conduit a metal pipe led the power water up a short incline to the summit of the wheel. The pipe was continued on across the top of the wheel—in a direction parallel to the axis. The pipe was then continued downward, but with a greatly reduced diameter.

Perhaps it will be well to insert a brief explanation covering the principal features of an old-time wheel, so that our further consideration may be facilitated. There are five chief parts into which the structure may be divided. There is a shaft or hub, the arms or radial rods, the shrouding, the soling and the floats. The shrouding is the aggregate of the segmental pieces that corresponds in position to that of the felloe in a carriage wheel. The soling is the peripheral face. With the shrouding, it forms a kind of circumferential trough. The soling constitutes the convex flooring. The floats are the blades extending across the convex face of the wheel. They lie in the trough. In the case of the Burden wheel, the power water is fed to the wheel from the pipe length, or cylinder, which extends across its crest parallel to the axis.

The designer of the Troy wheel was Henry Burden, who came from Scotland to the United States in 1821, when he was 30 years of age. The wheel was constructed for the purpose of supplying power to an iron and nail factory whose business had become very considerable. The works were, and are still, located on the banks of a small tributary to the Hudson known as Wyants Kill. Not far away from them was Burden Falls which dropped the water of Wyants Kill a vertical distance of about 50 feet. Below the falls were a number of rapids. Altogether, there was a total available head of about 70 feet. Wyants Kill is the outlet of four lakes located some 10 miles distant. At the works, the drainage available is perhaps 36 square miles. A dam was built in the region of the four lakes and thus created a fifth. This proved to be a solution of the problem of storage and regulation. There would be, in fact, plenty of water at all seasons.

There were, it seems, five small water wheels; but Mr. Burden preferred to construct a single unit of large size. It is understood that construction began in 1838. In its early form, the wheel was operated not without difficulty. About 1851 it was rebuilt. In the earlier wheel one of the journals became excessively heated and broke off. In the rebuilt wheel, hollow journals were employed and provision made for the circulation of water over them. The wheel of 1851 is the same wheel whose south supporting pier gave way a few weeks after the Great War started. Only a few replacements seem to have been necessary. A wooden stave pipe was employed at first instead of the later riveted iron pipe. And about 1882, the segment gearing was replaced. These replacements and ordinary repairs sum up the maintenance of the wheel during a period of forty-five years, the wheel having stopped in 1896.

The dam which provided for the head race was only a few hundred yards above Burden Falls, so that no great length of water-way was required.

The great wheel was constructed mostly of wood. The soling consisted of Georgia pine in heavy pieces 10x10 inches in section. To these the 264 iron rods, which were of 1½-inch size, were secured. On this same soling, on top of the ends, the segmental gearing was attached.

It will be gathered from the foregoing that this great wheel must have been a heavy affair. And indeed, so it was. It is estimated that in a soaked condition the wheel must have weighed about 250 tons, so that 125 tons came on each bearing.

The power multiplication by the gearing was about 35. With the water wheel rotating at 2½ turns per minute, the flywheel would rotate at about 87½ turns per miute. This was the rate considered desirable. With the fluctuations of load in the shop, it was accordingly necessary to readjust the flow of the water in order to maintain a constant speed at the flywheel.


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Mr. F. R. I. Sweney has studied the Burden wheel, and has calculated its efficiency. He finds that at a constant flywheel speed of 2½ rotations per minute, a horse-power of 278 would be developed at an efficiency of 84.25 per cent. This efficiency relates only to the matter of hydraulics and takes no account of the frictional losses in the gearing.

## The Needs of the Patent Office

(*Continued from page 592*)

vast extent of the developments in the arts as a warning against undue expectations of financial award from the receipt of a patent grant. It would benefit the public and the Office highly if the number of applications and patents granted were cut in two; if trivialities that now burden the processes of examination and the records were substantially reduced.

There are many other improvements that have and could be suggested, such as making the entrance to the patent bar more rigorous, limiting the number of claims in an application, restricting the life of a patent in accordance with its extent of prosecution in the office, etc., etc., but no attempt will be made to further treat this subject-matter than has already been done. It would take a volume to discuss its ramifications in all its phases. An exception, however, to the termination of this treatment must be exercised with relation to one thought. It has frequently been suggested that an exhibit of the more striking results of invention be placed on view in the Patent Office. Such an exhibit of models of the most notable inventions would undoubtedly bring a measure of public interest to the workings of the Office that does not now exist. The Patent Office needs the interest of the public very much. Not only would the public's interest to the benefit of the Office be aroused in a display of the fruits of the highest and most characteristic genius disclosed by the American people, but the public would be reciprocally profited by the receipt of information, in an intensified and never-forgotten form, of the beneficial effect the patent system has had in arousing that genius.

Once the public becomes conscious of the stupendous service to humanity conferred upon it by the activities of inventors, and the relation of the Patent Office to their output, it may not be beyond the limit of imagination to visualize a condition when the expectations as sketched in this paper may actually be realized.

## Surveying America's Snows

(*Continued from page 594*)

stream-flow is the occasional lack of precipitation during April-June after the snow survey has been made. It has generally been considered that small amounts of rain such as usually fall in the semi-arid West have little influence on stream flow. And this is particularly true in the autumn when the rain falls directly upon the soil. However, in the spring when the snow fields stretch far down the slopes of the mountains toward the stream-gaging station, the greater part of the precipitation combines directly with the snow and obtains an "untaxed" passage with the latter into the stream below. Consequently, the lack of normal precipitation in April-June, when the snow fields are melting, causes a shrinkage in the seasonal percentage of the run-off indicated by the snow survey. This problem is met by postponing until the first day of May the final forecast of the stream flow in order to use the precipitation, the temperature, and the run-off for April as factors in determining the subsequent flow.

According to Dr. Church, a fallacy long prevalent has until the present prevented the application of snow surveying estimates to wide areas. This fallacy is the belief that storms are spotted and basins individual in their character so that the snow in one basin is not indicative of the relative amount in the next, and that even the snow cover in one part of a basin is not comparable to that in another.

"While this is particularly true in summer," he went on to explain, "and within narrow limits also in winter, the general correspondence of the stream flow in basins along the axis of the Sierra Nevada for distances of 150 miles, usually on one side of the range and sometimes on both, indicates the similar correspondence of the snow cover. Indeed, over a period of 9 years the usual maximum divergence has been between 8 and 15 per cent. The cause of the close correspondence is doubtless due in large measure to the heavy contribution by the 'big storms' that cover a large part of the range as they pass eastward. Hence, the result of a careful snow survey in any basin can usually be applied within 25 per cent to any other, and a series of surveys at wide intervals along the summit of the range will indicate the direction in which an increase or decrease in seasonal percentage of snow cover is to be expected."

## Wanted: An Inexpensive House

(*Continued from page 596*)

only to selected contractors, who are given exclusive rights in certain territory.

Building one's own home at best these days is costly business. There is no escape through sheer good luck. Here and there some fortunate person may come across an old-fashioned house which requires certain minor improvements to bring it up to date—to make it available for the persons of today, so to speak. There are thousands of such houses throughout the land, which, lacking the very latest word in appointments, are apt to go begging for buyers. As a general rule such old houses include a most desirable piece of ground, with fine fruit trees, shade trees, flowers, hedges, and so on. Such things are priceless in the sense that they cannot be produced overnight to adorn the new home.

Much can be done with old-fashioned houses. With the dismantling of National Army cantonments here and there throughout the country, one can pick up various bits of equipment and material for remodeling old houses. Plumbing supplies, lighting fixtures, wiring materials, wall board, furnaces—all these things are available at low prices at the dismantled cantonments. All in all, an old house is apt to contain better lumber than the newer houses, and if the foundation, sills and main members are found to be in excellent condition, one can purchase such a house with full assurance that one has a good foundation on which to build and improve and finally evolve a comfortable and worth-while home. Here, indeed, is a first-rate opportunity for the man who is handy—and the woman, too, for there are many little touches about such a house that await the feminine mind and hand.

## Venezuela's Mountain-Climbing Oil-Burning Locomotive

(*Continued from page 597*)

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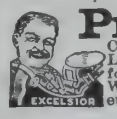

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Yet another departure in railway operating methods in Venezuela is the substitution of electric trolley for steam power on short, fairly level stretches on the coast, about La Guaira, and on the mountain plateau about Caracas, which doubtless will be followed by like conversion on a larger scale elsewhere in the republic. These suggest further opportunities for American equipment and supply interests.

## Music From Glass

(*Continued from page 598*)

perhaps a goodly total—scattered over the world. They are, in America at least, more of a curiosity than anything else. The sweetness and beauty of tone appears to be undeniable. But, apparently, the quality of the sound is such as to act unfavorably upon the nerves of some hearers. The musical critic, Fr. Rochlitz, in 1798, writes warmly in defense of the harmonica. He thought that it was as little injurious as any other expressive instrument. He recommended restraint in the enjoyment of this variety of music and thought its soft and pleasing tones should not be permitted to occupy the attention too much at night.

The success of the early harmonicas led to the desire to improve and vary. The effort was made to substitute something else for the human hand, but the success appears to have been only an indifferent one. There was difficulty in getting or continuing to get the peculiar and ethereal tone possible with the hand. However, the Abbot Mazzuchi invented a variety of harmonica which substituted the violin bow. The bells were inclosed in a case. It is said that the tones from this instrument were less exciting to the nerves of sensitive people. Another variation from the Franklin type uses little pegs with a pad at the end made of sponge as the means of vibrating the glass.

At the Metropolitan Museum of Art, New York City, there is (No. 1820) an English instrument consisting of 24 glasses standing on feet. There are one or two omissions, but the range appears originally to have been two complete octaves and two notes. At the same museum is an example of the Franklin type (No. 1211). This is a glass harmonica of 35 hemispherical glasses arranged on a rod. That is, the rod is placed horizontally and the various glasses are arranged on it in vertical "planes." This instrument dates back to the eighteenth century. The glasses originally provided a range of three octaves, but there are one or two missing. The diametrical sizes vary from 10½ to 3½ inches, and all are contained in a suitable case.

Benjamin Franklin's harmonica is not to be confused with musical glasses. It is, in reality, a mechanical device and not a mere collection of glass vessels. As this instrument seems never to have been essentially improved, the reader may be interested in learning precisely how it is constructed and operated. I follow Franklin's own account, given in a letter dated London, July 13, 1762.

Thirty-seven notes are desired. But a lesser number of glasses may be used. These are, each of them, approximately hemispherical. At the pole of the hemisphere is a neck not unlike that of an ordinary bottle. The largest diameter is 9 inches, the smallest 3. The diametrical size varies by intervals of ¼ inch; so that altogether there are 25 different diameters. A half dozen or more glasses are to be blown of each size and from these 150 or more hemispheres the 37 desired are to be obtained. The thickness of the glass at the edge is to be 1/10 inch or even less. The glass thickens somewhat as the neck is approached. This neck will vary for the different sizes. In the largest the neck will be, perhaps, 1 inch deep and 1½ inches wide within. The depth of the neck of the smallest glass should not be less than ½ inch. Having accumulated the considerable stock of hemispherical shapes, one is ready to begin the business of getting 3 octaves and 1 note from the lot.

A selection is made with two objects in view. First, one keeps before him the purpose of getting 37 notes that are either exactly the ones desired to make up the range or else are a trifle too sharp. Second, one seeks to get glasses that will fit fairly well, the one within the next larger. Assuming now that the choice has been made, one marks each glass with a diamond in such way as to indicate the note it is finally to utter. The glasses that are too sharp are reduced in pitch by grinding them in a zone of an inch or so in latitude, this zone being next the neck. Naturally, the glass should be tested from time to time to determine when it has suffered precisely the right reduction in pitch. Franklin recommends that as the right note is approximated, the glass be wiped clean and dry before testing, as the tone is flatter when the glass is wet. If the grinding be done by short stages near the finish, great exactness of pitch may be obtained. If, through inadvertence or otherwise, a glass be flattened too much, the brim may be ground off to remedy the matter. But this calls for polishing in order that a smooth surface may be present to the hand of the player later on.

The glasses, once they are tuned, are mounted in proper order upon a suitable spindle. As the general assemblage of glasses on the spindle produces a conical figure, viewed as a whole, the wooden case in which the group is to be arranged may follow this somewhat. That is, the case, while not departing from a form having a rectangular cross-section, may nevertheless taper toward one end. Franklin's case opened along a horizontal plane at a level intermediate between top and bottom. The spindle with its glasses upon being mounted in place was so disposed that upon opening the case the upper halves of all the hemispheres were disclosed. At the larger end of the spindle, a suitable fly wheel is mounted. A treadle is arranged, by suitable connections, so that the foot is enabled to rotate spindle and glasses. The spindle is set horizontally and mounted in brass gudgeons. Franklin's harmonica had a spindle of "hard iron," round in section, and tapering from a diameter of 1 inch at the fly-wheel end to ¼ inch at the other end. The big end is squared for the wheel. Franklin used a mahogany wheel 18 inches in diameter and rather thick—thick enough in fact to conceal a 25-pound weight of lead near the circumference. The wheel had six spokes, apparently. A pin of ivory was set in one and over it was passed the loop of the string connected with the treadle. Franklin states that the pin was located about 4 inches from the axis.

The fixing of the glasses on the spindle is done with the aid of corks. Thus, a cork is fitted into the neck of a glass and is allowed to project somewhat. The object of this projection is to prevent actual contact of glass with glass. When the corks have all been duly fitted, they are perforated to receive the spindle. Naturally, the perforations correspond with the spindle size at the proper location along its length. "When a glass is put on, by holding it stiffly between both hands, while another turns the spindle, it may be gradually brought to its place."

The playing is done by operating the spindle with its complement of hemispheres and laying the finger on the various glasses as the several notes may be required. The brim is the place from which the note is drawn. Franklin recommends that the tone be got by rotating the glasses away from the finger rather than toward it. His instrument had G (somewhat below "a common voice") for its lowest tone and then included all the usual tones in the three octaves above. The fingers are to be soaked in water, and are to be free from all greasiness. A little fine chalk may be used at times in order to bring the tone out the better. A considerable advantage is pointed out by Franklin—once tuned, retuning becomes unnecessary.

## NEW BOOKS, ETC.

THE USE OF COLLOIDS IN HEALTH AND DISEASE. By Alfred B. Searle. New York: E. P. Dutton and Company, 1920. 8vo.; 120 pp.; illustrated.

Ostwald tells us that all life processes take place in a colloidal system; Sir Malcolm Morris, in his foreword, reminds us that this is equally true of normal body fluids and secretions and of bacterial toxins. If, then, medicines were administered in a colloidal state, careful investigators conclude that their remedial value would be higher. This book tells what results have already been achieved, and how scientific chemistry may surmount the difficulties presented by the instability of colloidal substances. It is a valuable contribution to a growing school of thought.

WHAT BIRD IS THAT? By Frank M. Chapman. New York and London: D. Appleton and Company, 1920. 12mo.; 144 pp.; 301 birds in color.

To the nature lover, the question put by this title is constantly recurring. In this unique little guide, the Curator of Birds in the American Museum of Natural History makes it easy to identify our feathered friends. His exceptional facilities have been drawn upon to the fullest extent, and the result is a work picturing and describing every land bird east of the Rockies. We have the distinguishing marks, range, nest, eggs, and song of each, and the localities and seasons where and when it may be looked for. The original treatment will at once strike the enthusiastic amateur.

THE NEW MERCHANT MARINE. By Edward N. Hurley. New York: The Century Company, 1920. 8vo.; 296 pp.; illustrated.

Mr. Hurley, having served his country to such splendid effect as chairman of the Shipping Board and president of the Emergency Fleet Corporation, leaves this book as a monument to our intensive achievements and a guide to future policy. With the history of American shipping as a background, his stage is occupied by sound suggestions. We have perils to avoid and opportunities to develop; these two objects are greatly forwarded by the thorough knowledge of conditions this work offers the foreign trader and the general reader. It enables us to think in terms of the future, and to shape the policies of the present to eventual supremacy on the seas of peace. It is ships that are rebuilding civilization, and ships that must protect and maintain it.

LANGUAGE FOR MEN OF AFFAIRS. Vol. I. Talking Business. By John Mantle Clapp. Vol. II. Business Writing. Edited by James Melville Lee. New York: The Ronald Press Company, 1920. 8vo.; 1192 pp.; illustrated.

Vol. I., 'Talking Business," deals with the special language problems of the business man. How he puts his proposition often means success or failure; he cannot rely entirely upon the merits of his case, for his rival's probably has a few merits of its own. He must know how to best bring out the strong points and overrule objections, all in a winning and human way. Vol. II. exhibits the technique of business letters, reports, and advertising copy. The articles are written by men who are one with their subject. To catch the attention and subtly guide the mind of the prospect is a fascinating occupation that is here set forth step by step with thoroughness and clarity. The man who would increase the power of his tongue and his pen cannot do better than turn for help to this substantial work.

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THE FARM TRACTOR IN 1920

# SCIENTIFIC AMERICAN

*A Weekly Review of Progress in*

INDUSTRY · SCIENCE · INVENTION · MECHANICS

TUNING UP A GIANT GERMAN ALL-METAL AIRPLANE FOR A LONG FLIGHT.—[See page 609]

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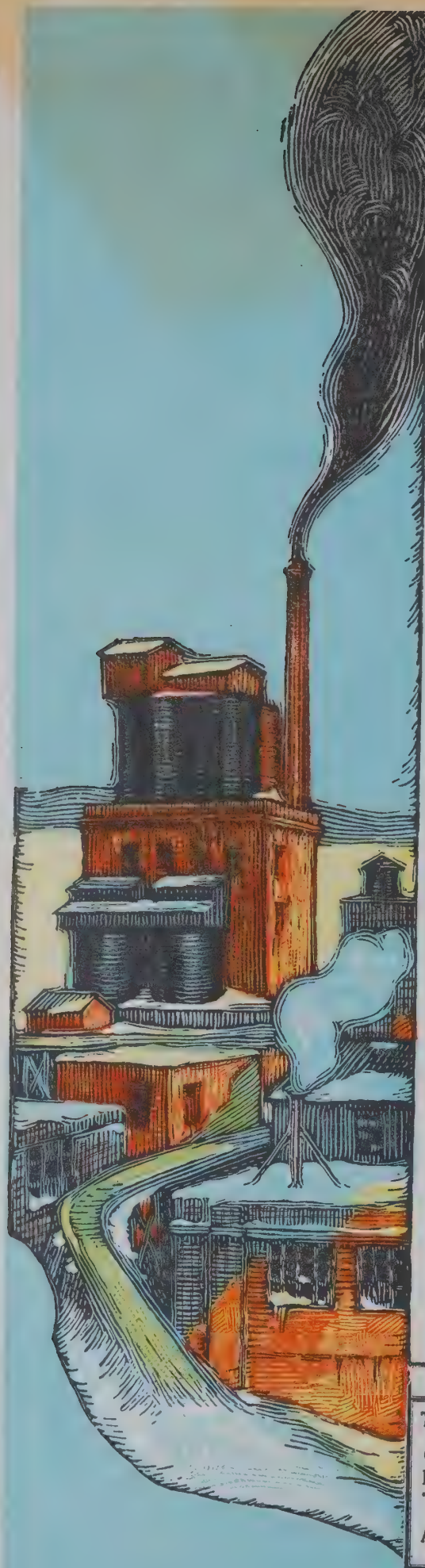

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SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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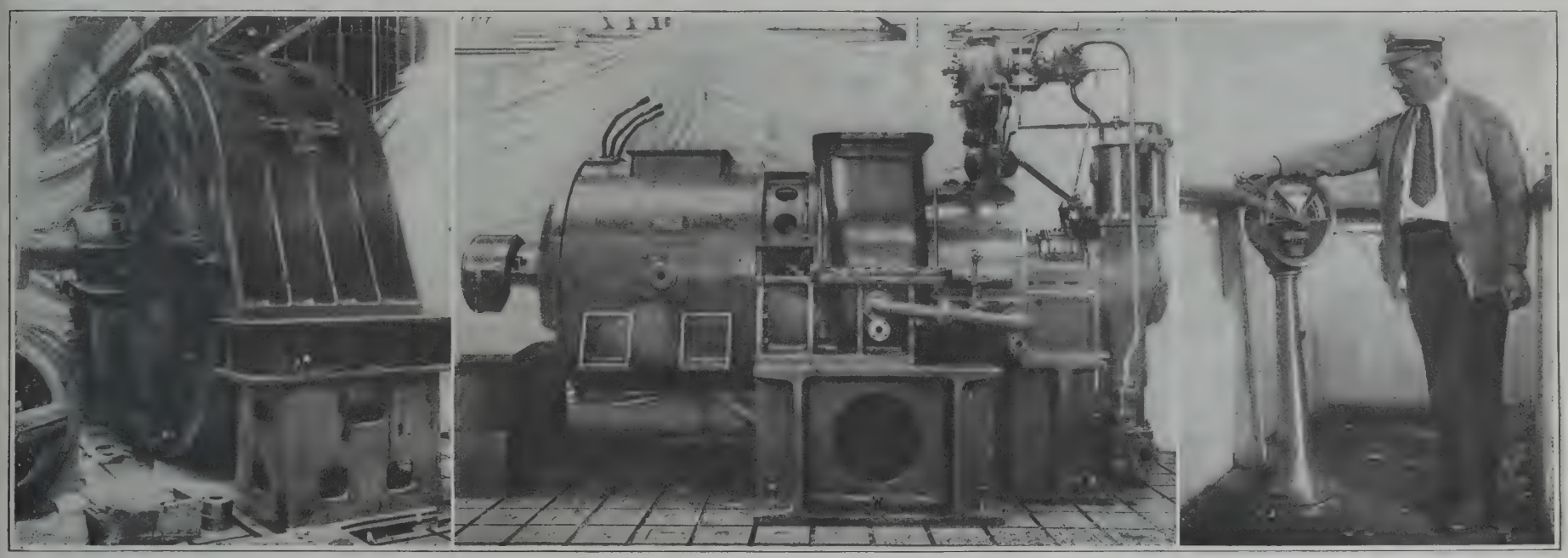

*Left:* The induction motor which, at 100 revolutions per minute, develops 3,000 horse-power for driving the single screw. *Center:* The steam turbine and generator unit which supplies alternating current to the single induction motor. *Right:* Chief Officer of the "Eclipse" at the safety steering device on the bridge. One man can control the movements of an electrically-driven vessel almost as easily as a motorman can drive a street car

**Some features of the electric drive used aboard the S. S. "Eclipse," one of eleven Shipping Board freighters to be so equipped**

## Electric Propulsion for Our Merchant Marine

EVIDENTLY, electric propulsion of ships has reached that stage in the development of a new art at which general recognition of its value is shown by rapidly extending use. The latest proof of this is shown in the fact that within a few weeks, the United States Shipping Board steamship "Eclipse," which is being fitted with electrical propulsion, will be placed in service. This is one of eleven other freighters of the Shipping Board's fleet which are also being equipped with the electric drive.

"Eclipse" is a vessel of 11,868 tons. The electric propulsion plant which is being constructed by the General Electric Company has been installed and the vessel will soon be placed in service. The plant consists of a steam turbine generator, directly connected to an alternating current generator, the current from which is fed to an induction motor on the propeller shaft, which at 100 revolutions per minute develops a shaft horse-power of 3,000. One of the great advantages of the electric reduction gear is that the speed of the ship and its general maneuvering, so far as the motive power is concerned, can be controlled from the bridge by means of the safety steering device which is shown in one of our illustrations. The bulk of the Shipping Board fleet is equipped with the mechanical reduction gear, and when a considerable number of these electric installations are in service, it will be possible to make some interesting comparisons of the two methods and gather additional valuable data as to their respective efficiency.

Driving a ship by electricity means revolving the propeller shaft from a motor just as trolley cars are driven by motors on the car tracks. To supply "juice" to turn this motor, a generator must be operated somewhere else in the boat, just as generators in power houses make current for street railways. On shipboard these generators may be driven either by an economical steam turbine or by a Diesel engine.

The records of the battleship "New Mexico," the U. S. Navy's first electric ship, show that oil consumption is lowered about one-third by the electric drive, while a greater and more flexible power is attained with far simpler mechanism requiring fewer operatives. It is even possible for the gigantic "New Mexico" to run at cruising speed with an engine room crew of one man, the electric mechanism requires so little attention. Of course, the great battleship will never operate so short-handed, except in emergency, but it can be done.

The idea of driving a huge merchant ship through the seven seas almost with the ease a motorman drives a street-car through city streets may seem humorous, but there is no humor in the basic scheme. It is not only possible for an officer to run his boat with small levers on the bridge, but this is being done. The economies of utilization of hull space, and of fuel are such that students of shipping are beginning to realize what the electric drive means for the rising merchant marine of this country.

Strange to say, however, the first application of the electric drive principle was made on a type of vessel closely resembling the merchant ship, although in reality it was a naval collier—the U. S. S. "Jupiter," launched in 1912. The immediate success of this installation was what paved the way to the adoption of the electric drive in the navy where all of the capital ships of the future will be thus propelled.

Copyright Edwin Levick

**The "Cuba"—first electric-drive passenger ship. The sister ship to the "Cuba" is the "Florida"**

## Synthetic Benzine

THE remarkably interesting and important announcement was made in *Flugwelt* that certain German scientists have succeeded in producing synthetic benzine. It has been found that in the presence of the coal tar of lignite and when heated under a high degree of pressure, hydrogen combines with the hydrocarbides contained in coal tar.

This discovery was made in the laboratories of the Badische Anilin u. Soda Fabrik. The general statement is made that it has been found possible to produce hydrocarbides analogous to those found in petroleum by means of high pressure, taking carbon monoxide and hydrogen in the presence of suitable catalyzers.

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# SCIENTIFIC AMERICAN

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## The Assured Future of the Automobile

A THOUGHTFUL survey of our modern civilization, as expressed in the broad field of engineering, teaches us that there are certain industries, which because of the enormous benefit they confer upon mankind, become so thoroughly interwoven with the fabric of human life and activity, that they may be considered to be as permanent as civilization itself. In proof of this statement, it is sufficient to mention the railroad and the steamship. Eliminate both or either of these, and civilization, as we know it today, would cease to exist.

And what steam has done for transportation during one hundred years of development upon sea and land, the internal combustion motor has equaled, and in some respects excelled, in a brief twenty years of development upon the hitherto neglected highways of the country. This astonishing fact is little understood by the general public, so let us look at a few of the incontrovertible facts.

There are today in the United States some 7,000,000 motor vehicles. If we assume a conservative yearly mileage of 3,000 miles per car, the total mileage must be 22,000,000,000 miles per year; and if we assume an average of three persons per car, we arrive at a total passenger mileage of 66,000,000,000 miles. Compare this with the figures for 1919 as given out by the Association of Railway Executives, which claim a yearly passenger mileage of some 46,000,000,000 miles. So that this lusty young giant in the field of transportation has a total passenger mileage to its credit nearly 50 per cent in excess of that on our entire railroad system, with its 260,000 miles of track.

Again, in 1919, automobiles, on a basis of 300 days in use and an average of only two persons per car, carried 4,535,000,000 passengers. Compare this with the latest Interstate Commerce Commission figures which show that the railroads carried in 1918 1,124,000,000 passengers, or one-fourth of the number carried in automobiles.

But, says some doubting Thomas, you are comparing two vastly different things; automobile riding is for pleasure—mere junketing, whereas railroad travel is serious—a business necessity. He will tell you that the automobile "craze" will have its day like the bicycle craze, which is as dead today as a door nail. To this it is sufficient to say, first, that the bicycle passed into seeming eclipse because it was overshadowed by the automobile and second, that statistics show the bicycle industry was never more flourishing than it is today, more bicycles being manufactured yearly than there were in the palmiest days of the nineties.

But the real significance of the automobile, as a leading utility in our industrial and social life, has recently been determined by a questionnaire conducted by the National Automobile Chamber of Commerce, which was sent to automobile license holders, selected at random from the registration lists of ten widely separated States. The answers received in reply to the first 10,000 cards of this survey are very illuminating, since the results may be considered to be highly authoritative and reliable.

We find that 10 per cent only of the cars are used exclusively for pleasure and that 90 per cent of them are used more or less for business; that 60 per cent of the average car mileage and no less than 78 per cent of the farmer car mileage is to be credited to business; that 34 per cent of the average mileage represents the substitution of the automobile for the trolley or the railroad and the use of the car where there is no other means of communication; and lastly and most important of all it is found that the average car owner, according to his own testimony, adds 57 per cent to his output through use of the automobile, and that the farmer adds 68 per cent to his efficiency.

Now consider the fact that more than 2,300,000 families have been enabled to live in the suburbs or otherwise improve their home surroundings, and that a working force equivalent to 1,600,000 laborers is being applied to farming, and we think it will be agreed that so far from the automobile being a mere instrument of pleasure, it is an instrument of utility that has woven itself so closely into the fabric of our modern social and industrial life, that it has become beyond all question a permanent part of our civilization.

Furthermore, we must not forget that in bringing these material benefits to the individual, the automobile has been responsible for the creation of an industry whose growth has been so phenomenal that today it stands as easily the second largest in the country. Thus, the capital invested in the automobile industry for 1919 exclusive of parts and accessories makers was $1,015,443,338, and in the same year the total motor vehicle production was 1,974,016. The value of this product was $1,885,112,546, which is equal to the value of the total annual production of anthracite and bituminous coal in this country. The industry employed 300,000 men in the production of motor cars and motor trucks, and its annual payroll was $374,933,856. With such figures in mind, no one will be disposed to question the statement of a well-known authority that "the greatest single new productive force in the development of the United States in the past twenty years has been the automobile."

Today the automobile industry, in common with all others, is passing through a period of readjustment, and there are many indications in the case of this particular industry that the readjustment is nearing completion and that early in the coming year everything will be in full swing upon a new and more solid basis. Of this we may all be assured, that there is not now nor has there been at any time any question of the permanent prosperity and the continued future growth of the industry. It is estimated that if the car market were confined merely to replacements, over 1,000,000 new automobiles would be needed every year. There are, as we have said, some seven million cars in the United States. There are in all Europe only about one million cars. It is the belief of automobile men that not until the rest of the world has as many cars as the United States will the industry in this country experience anything more than a temporary abatement in the demand. Should the day come when Europe, like America, has seven million cars, there will be a demand, merely for replacements, which will be from two to three times as great as the maximum number of cars that has ever been turned out in a single year.

## Shipbuilding Here and Abroad

AT the present time, according to statistics recently issued by *Lloyd's Register*, there are being built in the United States 312 vessels with an aggregate gross tonnage of 1,772,193 tons, as compared with 767 vessels aggregating 3,470,748 tons which were under construction in the corresponding period of last year. That we were building this fall not much over half of what we had in hand last fall is of course due to the fact that the great program of the Shipping Board is being rapidly completed, and no additional vessels are being laid down by the Board. An interesting fact is the large number of tankers which are now under construction. The United States is building 79 of these, of 545,302 total tonnage, and the United Kingdom is building 32, with a total tonnage of 232,758. Three other tank steamers are being built in other foreign countries.

Lloyd's statistics show that the United Kingdom is regaining her pre-war position in the world of shipbuilding. At the end of September this year, 961 ships were being built in British yards, and their total gross tonnage was 3,731,098 tons, an increase of 914,000 tons over the amount that was building a year ago. This represents an increase of 32 per cent for the year, and of over 90 per cent as compared with the figures for September 1913. Note should be taken of the fact that a large proportion of these ships are of considerable individual tonnage. Thus, there are now building in British yards 64 vessels of 10,000 tons or over, 57 vessels of 12,000 tons or over, 25 of 15,000 tons, and 4 vessels of between 24,000 and 25,000 tons.

Next to the United States comes Holland, which has in hand 165 ships of 423,400 tons. Italy is building 156 vessels of 365,313 tons, and France, 89 ships of a total tonnage of 292,608. Japan, with 72 vessels of 262,407 tons on hand, is building less than she was a year ago. Shipbuilding has declined, also, in the British Dominions, which have in hand 89 ships of 213,894 tons.

## Saving Steel in Bridge Design

IN the early, very early, days of engineering in this country, it was customary to speak of the "factor of safety" in a structure. The factor of safety was supposed to express the ratio between the maximum load which was supposed to come upon a structure and the breaking load. Not infrequently in steel structures, this factor of safety was as high as five; and thirty or forty years ago the same rough-and-ready method resulted in that magnificent structural material, the Douglas fir of the Pacific coast, being subjected in bridge work to a stress of only 1,000 pounds per square inch when its breaking strength was not less than 10,000.

A growing recognition of the unscientific character of the factor-of-safety method, coupled with a demand for reasonable economy, led to the substitution of the unit-stress method, in which the maximum stress to which the steel shall be subjected is stated, the unit stress varying according to the particular duty to be performed by the various members of the structure.

For many years past there has been a feeling among engineers that the unit stresses were too low for the highly reliable steel which is now available, and we note that a committee of the American Railway Engineering Association has proposed that the carrying capacity of existing bridges be rated on the basis of unit stresses, ranging up to the high figure of 26,000 pounds per square inch.

Now any competent modern bridge engineer will admit that 26,000 pounds per square inch is a perfectly reasonable figure, provided that the preparation of the strain sheet and the design of the details of the bridge are in thoroughly competent hands, and the inspection of the steel both at the mills and in the fabricating shops is conscientiously carried out by qualified men. A great reduction in the present margin between the working stresses and the breaking stresses can be safely met only if the above conditions are most rigorously fulfilled.

In some very interesting comments on this subject, *Engineering News-Record* lays emphasis upon the fact that the secondary stresses created during the erection of a bridge should receive very close attention if unit stresses are to be raised to the point which has been suggested. Live load stresses are all susceptible of measurement, but to determine secondary stresses, which at present are a matter of much uncertainty, it is suggested that they should be measured by means of gage points applied to the structure before its erection.

During the well-known reinforcement work which was done on the Niagara Railway arch bridge, it was found that gage points can be placed on bridge members for as little as a dollar or two per pair. Since the initial measurements would not add heavily to the cost, our contemporary considers that it should be quite clear that the preparatory work for giving complete future knowledge of dead load stresses in a bridge, and consequently of the total stresses, can be done at a cost so low as to be completely negligible. The alternative to this is to meet the secondary stress problem in a haphazard way by adding more metal to take care of it. It is to be hoped that this very practical suggestion will be followed out. Every reasonable proposal to prevent the use of unnecessary steel in bridges should commend itself to the civil engineer. We look to see this admirable suggestion incorporated in bridge practise.

## Electricity

**The Unusual in Searchlights.**—In a recent issue of *Elektrotechnische Zeitschrift* there appears a description of a decidedly novel searchlight installation aboard German warships. Two plane mirrors are used to throw out the beam of light, the searchlight itself being placed inside the hull of the ship and in a protected position, while the beam of light is passed up through the hollow steel mast of the ship and projected by a mirror at the top.

**A Snap-Switch Handle That Cannot Be Unscrewed** has been introduced by a leading manufacturer of electric appliances. This is accomplished by means of a ratchet built in it. The handle may be substituted for the ordinary handle. The ratchet escapement comes into play when the handle is turned in the reverse direction so that it cannot be loosened or removed. By using a small screw-driver on a screw which is well recessed in the center of the handle, the ratchet is released. These handles may be used to prevent the removal of "dead-front" insulated covers of safety panel switches.

**A New Canadian Niagara Power Project** is described in a recent issue of *The Electrician* of London. The new water-power development, which is now under way, purposes to utilize nearly the full drop between Lake Erie and Lake Ontario and require for maximum capacity practically all the flow now permitted Canada under the international agreement. It is known as the Queenston-Chippawa hydraulic development. The present scheme contemplates the development of 500,000 horse-power and 305-foot head, using ten 50,000-horse-power turbines, five of which have been ordered. A description of this work will appear in an early issue of the SCIENTIFIC AMERICAN.

**Why Clark Standard Cells Fail.**—The causes and effects of the cracking of Clark cells at the amalgam terminal and the formation of gas in the amalgam limb are discussed in Scientific Paper No. 390, "The Two Common Failures of the Clark Standard Cell," issued by the Bureau of Standards, Washington, D. C. The methods employed in an attempt to eliminate these defects are also given. It is shown that the cracking of the cell can best be prevented by a very simple expedient of using a cell blank in which platinum wire previously subjected to the action of zinc amalgam is employed as the negative terminal, and also that the effects of gas formation can be minimized through the employment of the smallest excess crystals required to insure saturation at the highest temperature at which the cell is to be used.

**Aluminum for Telegraph and Telephone Lines** is a subject that has received some attention in Germany, where the scarcity of copper has caused the telegraph administration to investigate the possibility of using aluminum for signaling plants. Difficulties were experienced in finding methods for making reliable joints in cables, resistances of several ohms being often observed on carefully made twisted joints. For bus bars, however, aluminum appears to be just as good as copper. Telephone condensers up to 2 mf. in capacity were made with aluminum foil and paper, with the same exterior dimensions as the ordinary tinfoil and paper condenser, continues *Elektrotechnische Zeitschrift*. On alternating-current tests the aluminum foil condensers were found to have much smaller losses than tinfoil condensers, the power factor of the new condensers being only one-fifth to one-eighth that of the ordinary type.

**Direct or Alternating Current?**—There is a decided tendency among certain groups of European engineers to put all direct-current electrification under a common classification as the "American system," and, accordingly, to assume that direct current is the only form of supply accepted in America for railroad electrification. This tendency is vigorously opposed by an author in *Elektrotechnik und Maschinenbau*. This German author maintains that little stress should be laid on the fact that direct-current supply was chosen for the Chicago, Milwaukee and St. Paul electrification, in view of the peculiar circumstances which affected the choice. First of all, he says, the already existing three-phase transmission lines lifted the burden of transmission-line construction from the backs of the electrification engineers, enabling them to get access to power at any point on the road, so that numerous converter stations could be easily erected all along its length. The author further declares that Swiss and German progress in single-phase traction is very little appreciated in America and that one important reason for choosing direct current for the road mentioned was the lack of time for investigation and trial in a period when any kind of electrification was sure to promote economy.

## Science

**League of Belgian Scientific Societies.**—Thirty-three scientific societies in Belgium have formed the Fédération Belge des Sociétés des Sciences Mathématiques, Physiques, Naturelles, Médicales et Appliquées, with headquarters in Brussels. The federation will aid the several societies in keeping up their publications, provide facilities for international exchange of publications, summon congresses, hold expositions, etc. The president for 1920 is Prof. de la Vallee-Poussin, of Louvain.

**"Physiological Reviews,"** published quarterly in Baltimore, beginning January, 1921, by the American Physiological Society, is the latest addition to the list of scientific journals designed to present periodical reviews of progress in particular fields of knowledge. Instead of abstracting individual papers separately, this journal will summarize and compare results, and a bibliographical list will accompany each article. It will therefore be a publication similar in purpose to *Ergebnisse der Physiologie*, the Harvey Lectures, and others of the same sort.

**The Writings of a South American Paleontologist.**—A complete edition of the scientific writings and correspondence of the South American paleontologist Florentino Ameghino, who died in 1911, is now in course of publication at the expense of the government of the Province of Buenos Aires, Argentina, and under the editorship of Alfredo J. Torcelli. The edition will run to a very large number of volumes, as Ameghino was the author of 179 essays and books, few of which are short while some are large volumes. They are at present difficult of access to most scholars.

**Submarine Photography from Airplanes.**—Writing in the *Geographical Review* on the subject of aerial photography as an aid to geography, Mr. Willis T. Lee, of the U. S. Geological Survey, deals at length with the application of this process to photographing and mapping submarine features. The visibility of objects at great depths in clear water from a point far above the surface has been a well-known phenomenon since the wartime period of "sub" chasing by airplane. It is said that objects 45 feet under water have been successfully photographed, and that with the proper plates and ray filters the presence of submerged objects invisible to the eye is revealed by the camera. It has been found possible to use this method of observation to some extent in detecting and mapping sand bars, shoals, drowned terraces and channels. Mr. Lee presents several photographs illustrating the results of the method. Not all photographs of coast lines reveal these subaqueous features. Certain conditions of the atmosphere and the water seem to be necessary for photographing them. "In studying the underwater features as shown in photographs," says the writer, "caution and careful checking in every possible way are necessary. Changes in hue in the photograph might be due to sediment in suspension rather than to differences in depth of water."

**Aridity as an Asset in Agriculture.**—The idea that an arid climate is a blessing to the farmer will strike most people as novel and paradoxical, but a good case in favor of this idea can be made out. In a valuable report on the Columbia Basin Irrigation Project, published by the State of Washington, the following facts are set forth regarding the influence of aridity on agriculture: The almost continual sunshine accelerates plant growth. The soil, constantly warm, prevents any cessation of root activity which would follow night chilling if cloudy weather prevailed in the daytime. An arid climate reduces harvesting costs and insures a higher quality of products, harvested without delay or spoilage by rain. The main point brought out, however, is that, with irrigation as a substitute for rainfall, water can be applied to the crops at the right time and only at the right time; also in just the right amounts. This fact is in accordance with current ideas in agricultural meteorology concerning the great importance of "critical periods" in the growth of any crop plant, when its exact requirements in respect to heat or moisture must be met in order to get the best results. The ideal plan would be to dispense with natural climate altogether and to grow all crops under controlled conditions of temperature, moisture, and probably other atmospheric factors. The above-mentioned report says: "The scant rainfall of the Columbia Basin area has been very beneficial for the future irrigationist. There has not been sufficient moisture to leach away the stored plant food, and at the same time adequate drainage has prevented the accumulation of alkali salts, which are the most soluble of the earth's constituents and are frequently found in poorly drained arid regions."

## Automobile

**England to Motorize Mails.**—There are indications that the General Post Office of England is considering a great revival and extension of motor services for mails, particularly in the more remote country districts. As will be remembered, there was considerable progress in this direction during the years immediately preceding 1914. The war, however, necessitated considerable changes, resulting in a wholesale abandonment of road services and a reversion to "as you were" conditions. Efforts are now being made to recover the ground thus lost.

**Peoria Taxes All Wheels.**—The city council of Peoria, Illinois, has adopted a new wheel tax ordinance effective October 1. Even bicycles and tricycles, ridden by children, must pay a tax of $2 a year. The scale for horse-drawn vehicles ranges from $2.50 to $10; motor buses, $10; motor vehicles, not motor trucks, $4 to $8 a year; and motor trucks, $5 to $15, according to horsepower. Firms engaged in manufacturing or dealing in motor vehicles will be required to pay an annual tax fee of $6 for every dollar's license fee issued. There is much opposition to the measure, but the council holds that the conditions of the public finance forces the action. This action is unusual in that all vehicles are taxed. The usual procedure is to tax only motor vehicles and allow other users of the highways to use them without payment of any fee. It is hoped that other communities figuring on levying a wheel tax will include all vehicles and not make the motorists bear the entire burden as is the established custom.

**Hauling Mill Work by Truck Profitable.**—In the average wood-working plant there are two uses for the motor truck. One is to truck in lumber or raw material and the other is to truck out the finished product—that is, to make deliveries to the purchaser. The trucking-out proposition has more to it than many a wood-working plant has so far developed; it is practical and economical to make truck delivery over comparatively long distances if the road permits it. Investigation into truck service and cost bring to light the fact that in competition with short railway hauls, one can truck millwork and other items in manufactured wood at a greater saving than he can truck such heavy items as sand, gravel, cement and brick. The reason is that the heavy items take a very low freight rate, which motor trucking must compete with, while manufactured woodwork takes a comparatively high freight rate, consequently it can often be delivered by truck fifty or more miles more economically than shipping by railroad and there is a saving of one or two handlings.

**Riveting Ring Gears.**—Where the ring gear is attached to the differential housing by rivets which have become loose, the first step is the removal of the old gear by chipping off the rivet heads with a sharp chisel in order to drive the old rivets out or to drill out the rivet head if this is of the countersunk type. After the rivets have all been driven out and the old ring gear removed, the flange on the differential case should be carefully gone over and all upstanding burrs should be smoothed down with a file. Any irregularity on the flange will result in the ring gear being out of true, as far as its meshing with the driving pinion is concerned. Hot riveting is preferable to cold riveting because when the rivets are put in red hot they fill the holes better as they are headed over and additional holding power is secured by the cooling shrink. In order to make a neat job of riveting it is imperative to use a rivet set. A skilful mechanic may be able to form up a head with a peening hammer but this at best is a slow job and there is always some danger of injuring the differential casing or the gear teeth should the hammer slip.

**Tightening Bearing Cap Bolts.**—A point to observe is to make sure that the heads of the bolts are imbedded solidly in their proper position and that they are not raised by any burrs or particles of dirt under the head which will flatten out after the engine has been run for a time and allow the bolts to slack off. Similarly, care should be taken that there is no foreign matter under the brasses and the box in which they seat. To guard against this the bolts should be struck with a hammer several times after they are tightened up, and the connecting rod can be hit sharply several times under the cap with a wooden mallet or lead hammer. It is important to pin the brasses in place to prevent movement, as lubrication may be interfered with if the bushing turns round and breaks the correct register between the oil hole in the cap and brasses. Care should be taken in screwing on the retaining nuts to insure that they will remain in place and not slack off. Spring washers should not be used on either connecting rod ends or main bearing bolts, because these sometimes snap in two pieces and leave the nut slack. The best method of locking is to use well-fitting split pins and castellated nuts.

# Power and the City

## Some Facts and Figures on How Los Angeles Has Harnessed the Distant Mountain Streams

By Crittenden Marriott

A FEW years ago, when Los Angeles completed its 235-mile aqueduct to bring water from the mountains, a great deal was published concerning the magnitude of the work and the benefits that would follow its creation. It is safe to say, however, that few people noted and that fewer still have remembered that one of the great objects to gain which the people of Los Angeles spent $24,500,000 was the development of hydroelectric power.

Nearly everyone in the East thinks of an aqueduct merely as a means of obtaining water for drinking and other domestic uses—and in the West, perhaps as an adjunct in near-city irrigation. But when these primary needs have been met that of power remains. A great industrial city depends on cheap power as much as it does on drinking water. Coal is lacking in the West; and though fuel oil is at present abundant it will not last forever. But water power will.

The builders of the aqueduct realized this, and one of the objects of their work was to develop water power and to transmit it electrically to the city in order to build up there a vast industrial system. Today this object has become paramount; and the possibilities of the situation can no longer be blinked at. The bald facts are that Los Angeles today has 41,000 horsepower, municipally owned, in use and for sale; and before the close of the present year it will have 98,000 horse-power. And this is only about one-third of the power available from the aqueduct and its adjuncts, the other two-thirds waiting only on the installation of the necessary power-plant machinery to be available for use. This enormous potential power is due to the great fall between the intake of the aqueduct and the city and to the fact that the same water can be used over and over again, the total fall effective for power use being 1,960 feet. Its development has changed the destiny of Los Angeles, transforming a commercial city, dependent almost wholly on the agricultural and horticultural output of its "back country," into an industrial city whose possibilities are unlimited.

The reliability of the aqueduct power has just gone through a very severe natural test. For three years the Southwest, and the Pacific coast especially, has been going through a very unusual drought; and the rainfall for the winter of 1919-20, though far above that for the three winters preceding, was only just about normal. The State Railroad Commission, which in California has control of the water power of the State, has this year sent out an appeal to all power plants to utilize all existing power in the State to the utmost and not to let any available water run to waste. It has even been suggested that all the power plants in the State pool their resources for the common supply. Of all the plants the Los Angeles aqueduct alone was able to turn over a large amount of power to other companies for distribution and use outside the city.

So far as the water itself is concerned, the city, during the three years' drought, has greatly enlarged the suburban area to which it supplies water for irrigation; and it has just allotted for the use of the huge automobile tire factory (operating 33,000 spindles) which is about to begin operations, a supply of water double that used by the entire city of San Diego for all purposes. The total aqueduct discharge is 400 second-feet, equivalent to 258,000,000 gallons daily, which, in addition to supplies already developed locally, gives a total daily delivery of 325,000,000 gallons.

Of course the generation of hydroelectric power outside a city does not necessarily mean that the power is or can be reliably transmitted to the city workshops. However, all aqueduct power so far developed, and much of that not yet utilized, is or will be generated at plants that are very near the city and transmitted over lines whose capacity is far in excess of present loads. The lines to the city carry 100,000 volts; the city is encircled by duplicate 33,000-volt transmission lines (which extend to the harbor district at San Pedro, 16 miles away); and the industrial parts of the city are well provided with distribution power lines.

But what actual use has been made in a big way of the power that became available in some degree for the use of the city of Los Angeles three years ago?

Naturally the demand for domestic, office, street and home lighting had first to be met. After this came the steadily increasing demand of existing industries, large and small, including both those that changed their plants from oil-burning to electrical and those that bought the cheaper power offered by the city in place of that which they had theretofore bought from the two private power plants in the city. The difference in costs now and before the war makes it difficult to compare oil-fuel costs with electrical costs. However, a very careful estimate made by the local ice companies shows that their change to electricity has enabled them to save enough to cover the increase in wages of the last three years, the cost of treating the water, and the interest and depreciation on the new investment. In other words, electrical power at aqueduct rates has held the cost of ice making in Los Angeles to its pre-war standard; and the same is true of many other branches of industry.

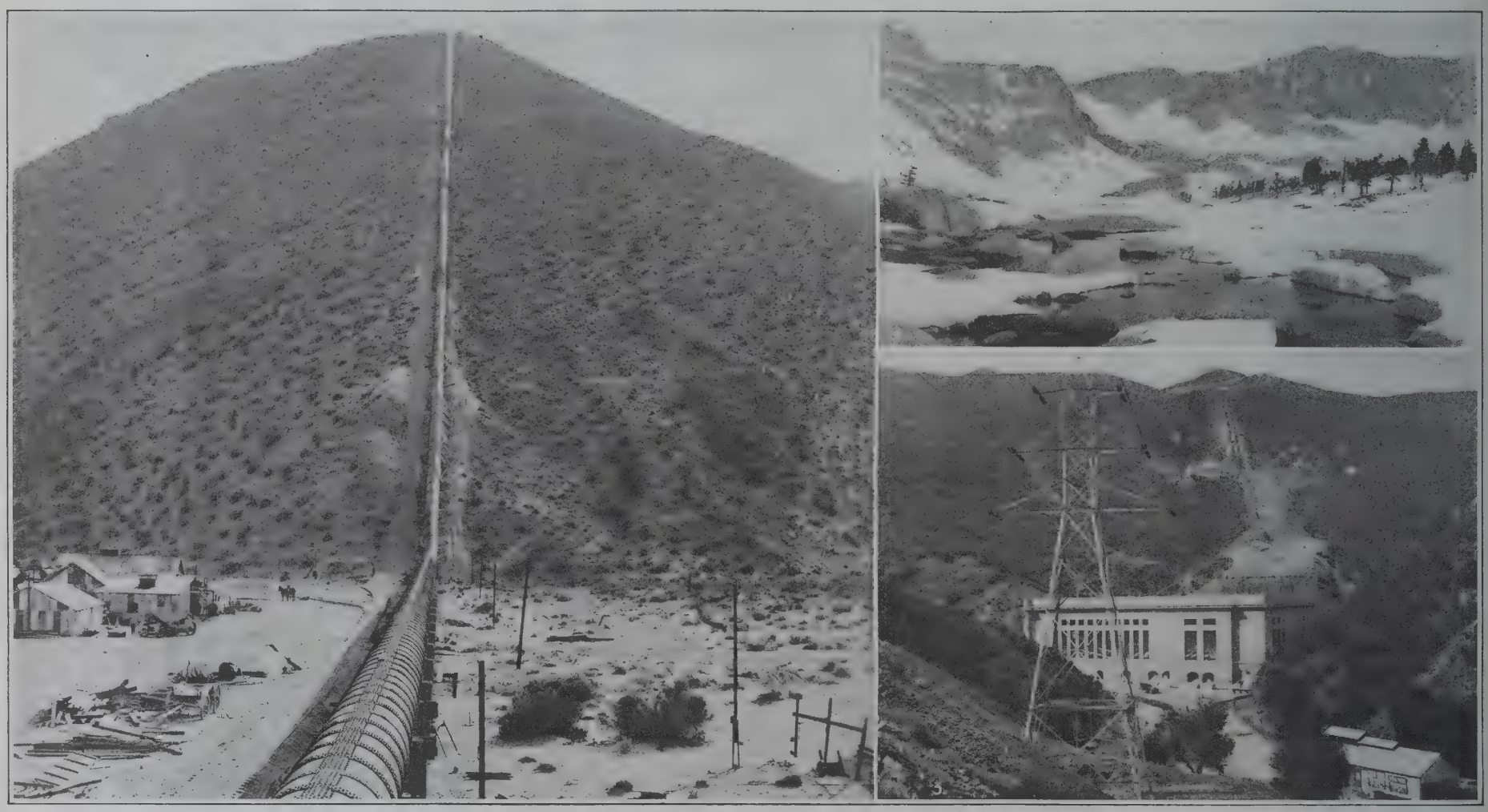
After existing needs were supplied, special attention could be given to supplying new plants built for the most part by industries that until then had been unknown in southern California.

As a rule men are pessimists when they are asked to transfer their business to, or to invest their money in, a region where no pioneer has marked the way for their particular line. At the very least they want time to consider. And it takes time to build factories, especially nowadays when both materials and labor are scarce and costly.

Nevertheless the vast advantages of cheap electric power of the aqueduct proved a powerful magnet. Since the power became available many small plants and some huge ones have been built and have gone into operation; others have nearly completed building and will start work during this summer or fall; and others have only just begun building.

The first great industry to succumb to the attraction of the magnet was that of ship building. The two big

(*Continued on page 620*)



1.—The Jawbone Syphon crossing a valley. "White coal" does not demand a level or even a downward course; it sinks to the bottoms of valleys and rises again to cross the mountain ranges. 2.—It is from such snow-covered slopes and mountain streams as these that water is obtained for the distant cities and towns. 3.—The San Francisco Power House No. 1, 44 miles from Los Angeles. The effective fall here is 938 feet, developing 69,000 horse-power. The high-voltage transmission line appears in the foreground, the penstocks in the background

**Factors in the conversion of melting snow into electric power and light and heat for the distant cities and towns**

The giant Staaken monoplane which carries a crew of two pilots and two mechanics in a cockpit atop the fuselage, and eighteen passengers in the comfortable cabin

## The Unusual in Passenger-Carrying Airplanes

By Alfred Longville

SOME very radical changes are being introduced in aviation of late. Just as we had settled down in the comfortable belief that the passenger-carrying airplane, to be truly orthodox, had to have a number of engines each of which drove its own tractor or propeller screw, along came several new machines which cast aside our fond beliefs and start aviation off on a new course. He would be a brave prophet who would attempt to picture the winged passenger-carrier of the future, in view of the many new and promising ideas now being worked out.

The latest F.I.A.T. 12-seater biplane is a leader among the aeronautical revolutionists, so to speak. Instead of following the accepted practice of a multi-unit and multi-screw arrangement for the propulsion, the engineers of the Fiat organization have designed their huge machine with a triple-engined power plant mounted in the nose of the fuselage and driving a single tractor screw, as in the usual single-engined tractor machine of the 2- or 3-passenger class. In the new F.I.A.T. machine the engines are mounted side by side, each driving the single tractor screw through a gear box. Should any one of the three engines develop trouble, it is automatically thrown out of engagement; furthermore, simple arrangements are provided so that the pilot or mechanic may disengage any one of the three engines, thus enabling certain repairs or adjustments to be made while in flight. The combined horse-power of the three engines is 900 at 1,850 revolutions per minute; but the normal power developed during cruising flight is 700 horse-power at 1,600 revolutions per minute, giving a speed of 115 miles per hour instead of 125 miles per hour at full power. With two of the engines in operation 600 horse-power is obtained, which is ample to maintain cruising speed. From reports it appears that the Italian engineers have solved the problem of a suitable gear drive in a somewhat different fashion from certain French designs in which two or more engines are arranged in tandem to drive a single tractor screw.

Another departure from standard airplane design is the great German monoplane which forms the cover illustration of this issue. This odd machine is the German "Staaken," built in one of the Zeppelin works where efforts of late have been concentrated on the airplane instead of dirigible type of airship.

The most striking feature of the giant "Staaken" is the arrangement of the engines. Following the lines of the all-metal construction of certain German machines, the "Staaken" has an exceptionally thick single wing which is so braced internally, between the top and bottom surfaces, as to require practically no external bracing. The engine units are mounted in the leading edge of the wing, two on either side of the fuselage, offering a minimum of head resistance. In all, the airplane has somewhat over 1,200 horse-power, and carries 18 passengers and a crew of 2 pilots and 2 mechanics. The nose of the machine is hinged and swings back so as to form a doorway into the cabin situated in the forward part of the fuselage. The pilots and mechanics sit in a cockpit on top of the fuselage and above the single plane, which position affords excellent visibility in almost all directions.

The giant "Staaken" is the outcome of a whole line of giant airplanes developed by Germany during the latter part of the war, and intended for long-distance bombardment of Allied cities and military depots. The all-metal construction is carried out in duralumin. The span of the single wing is 105 feet. The speed of the machine is given as 130 miles per hour, which is exceptionally fast for a machine of such large proportions and great carrying capacity.

## Demolition Material as Fertilizer

AT the present time when fertilizer is so much in demand, various materials which could be used for this purpose should not be overlooked. From a French source we find it recommended to use lime and plaster material coming from demolitions, and it contains very useful fertilizing ingredients. Such material can find a very good use on land which is poor in lime and which is situated in the region around good-sized towns. The cost is scarcely anything, and the haulage to the spot would be practically the only

Giant Staaken machine in flight, carrying eighteen passengers with all the comforts of a railroad coach

expense. Material from demolition consists of dry mortar with some fragments of stone, that is, as regards the waste products which cannot be used again. The composition of mortar will be seen by observing how it is made up in the first place, mortar being formed in fact of sand and lime in varying proportions according to use. In general the makeup contains 30 to 40 per cent of lime which afterwards becomes partly transformed to carbonate of lime or chlorohydrate and nitrate. Nitrification is found to be most active in the walls of the ground floor, and there is also formed in many cases nitrate of potash. It will thus be observed

Nose of the Staaken machine, showing the hinged front which swings back so as to give access to the passenger cabin

that this material is rich in nitrates, and it can therefore be employed to advantage as a calcareous fertilizer and as a source of valuable nitrogenous substances. From the sand which it contains, this material is best adapted for use on clayey soil than on sandy soil. In fact, after the lime and the different fertilizing substances have disappeared, either absorbed by the plants or drawn off by water, the sand will remain in the soil and it acts to increase the mobility of light earth which would be a disadvantage, while it is precisely this lightening up which is desired in heavy soils of a clayey nature, hence the sand is very useful in the latter case. The material is found to have a specially good effect on meadows and wet pasture land which however is not of a marshy nature. It is favorable to the growth of vegetables such as beans, peas and the like on ground of this class. Such fertilizer is also good for plowed ground, and here the material should be incorporated at some depth in the soil and not spread on the surface, especially on damp soil, for this would reduce their effect. Aside from mortar and the like, we should also consider the use of plaster coming from demolitions. Its action as fertilizer is not as yet very clearly defined, but it is considered that this material acts not only as a lime fertilizer, but also has an effect due to the sulfur which it contains. On the other hand, it is probable that it facilitates the absorption of potash by plants and favors nitrification. In any event, its effects are noteworthy upon certain crops, such as pod vegetables (peas, beans), clover, buckwheat and others, and it increases their output considerably. Grapevines show its action to a marked extent, but root vegetables and cereals hardly at all. Plaster therefore should not be neglected, for it can be a source of great benefit to crops in many cases. Plaster material should be well pulverized before use as such plaster will usually contain various impurities such as pieces of stone, brick, mortar, etc. The amount to be used on the soil will of course vary according to the case.

## Making New Blood

A VERY remarkable discovery with regard to the blood has just been made by Dr. W. J. Penfold, director of the Australian Commonwealth Serum Institute, London. In the making of diphtheria and other serums considerable quantities of the plasma or fluid portion of horses' blood is used at the institute. The practice has been to allow the blood, after it has been drawn from the horses, to stand for some time to allow the red corpuscles to settle to the bottom. The fluid is then drawn off and used while in the past the red corpuscles have been thrown away. This struck Dr. Penfold as an economic waste so he began experiments in the way of injecting the corpuscles into the horses again. The results have opened up a new chapter in the study of the blood. It appears that the horse can easily and quickly form new fluid if the red corpuscles are put back into the blood. While the normal average amount of blood in a horse is 36 liters it has been found possible to take 48 liters in a week from a horse to which the red corpuscles are returned and that without its vitality being any more, if as much, affected as was the case with ordinary limited bleeding. The practice of returning the corpuscles has been extended to all the horses, between 30 and 40 in number, which are bled at the institute and wider experience is confirming the results of the earlier experiments. The composition of the blood remains practically normal.

It will take some time to realize anything like the full possibilities of so new and startling a discovery but it is bound to have an important bearing on the practice, as well as on the theory, of medicine. For instance there are diseases in which good results might be expected by an injection of the blood of those recovering from the disease but under present conditions the convalescents cannot spare the blood.

# Succeeding in Signal Engineering

## A Relatively New Field Opened to the Man Who Wishes to Learn While He Earns

By Raymond Francis Yates

SIGNAL Engineering is one of the newer specialized branches of railroad engineering. The problem of safe, reliable automatic signaling grew with our railroad transportation systems and today thousands of men trained in this work are employed in the design, construction and maintenance of signal installations. The signal engineer has come into his own during the past twenty-five years and today he takes his place on the engineering staff of all the important railroads.

The profession of the signal engineer is just as important as that of any other trained man on the staff, since his work is to devise ways and means of protecting life and property in transit over the railroads. This country, with its vast transportation systems, suffers considerable loss of life annually not through faulty signaling but through the human factor. Some of our most terrible railroad accidents have been caused by the engineer going to sleep or dying at the throttle. The signal operator is not infallible and some very serious accidents have occurred through neglect in this part of the present-day system.

When the engineer is asleep there is nothing to prevent the train from passing a signal. On the other hand, if the signal operator makes a serious mistake there is no way for the engineer to know it. These imperfections in the railway signaling systems of today have caused a great many lives to be sacrificed, and one of the most pressing needs of our railroads is a perfect automatic system that will almost, if not quite, eliminate the human factor.

While the railroads were under Federal control the problem of automatic signaling was put in first place among improvements. Experts claimed that the need was for a system similar to that in use on the New York subways. When a subway motorman passes a signal, the brakes are automatically applied and the entire train is stopped within a few feet. Of course, this system as it now stands cannot be applied to steam railroads, because the problem is not exactly of the same nature.

One reading the foregoing lines can easily recognize the future of signal engineering. Although the field is not extremely broad, it is nevertheless promising and holds a good future for those who master its details. There is especial need for men of an inventive turn of mind.

Mr. T. G. Cooke of the School of Applied Engineering of Chicago, Ill., is the Director of the Department of Signaling, and the writer decided to obtain his views on the subject, knowing that his long experience and standing in the field would enable him to give some very valuable and encouraging information to the young men who are surveying the field with the hope of entering this profession. The information imparted in the following lines is given through the courtesy of Mr. Cooke. Nothing but honest opinions are given and there has been no effort on the part of the author or Mr. Cooke to make the field appear more than it really is.

The first matter of importance in reviewing any field is education. The majority of signal engineers today are not college men. This fact certainly ought to encourage the young fellow who has an interest in the field and who cannot see his way clear to attend school. The need for signal engineers has been so pressing during the past few years that most railroads are willing to take on any young men to learn the work as far as they can by experience, and if this is supplemented by study the position of signal engineer is reached within four or five years. This is by no means a "sure-fire" proposition. Much depends upon the man, his ability, courage, honesty, and capacity to do things.

It is the general opinion among railroad officials that a signal engineer does not have to be a college graduate.

Of course, the college man enjoys an advantage over the self-trained fellow, but in this particular field experience counts more than in most professions and oftentimes offsets the advantage of college. A two-year special course in electrical engineering would be a wonderful aid to a man about to enter the signaling field.

One thing that makes it possible for a man to succeed outside of college is the absence of the need for involved mathematics. Mr. Cooke informed the writer that signaling engineering can be taught to a man who has a good, thorough knowledge of arithmetic. For the man who wishes to get out of the "rule-of-thumb" class as far as possible, however, the study of higher mathematics is essential. Work in signal engineering is seldom speculative enough to demand the application of the involved processes of calculus, differential equations, etc. It can be said in general that a knowledge of arithmetic will enable a man to master the details of signal engineering but it will not enable him to lift himself above the crowd who have a similar training.

The subject of signal engineering involves a study of mechanical, electrical and illuminating engineering. That is, the man to be proficient in signal engineering must have an electrical and mechanical education and should have an aptitude for work along these lines. The illuminating work is necessary but most roads at present do not lay so much stress on this as on the other features of the work. Mechanical and electrical work really form the foundation of signal engineering. The work itself in regard to the railroad is divided up into maintenance and construction. Both of these branches are subdivided into such work as testing and repairing, which is both electrical and mechanical.

The design and manufacture of railroad signal equipment is not done by the railroad companies. Several large manufacturers in this country carry on this work. The man who qualifies as a railroad signal engineer with several years of good practical experience will have little trouble in obtaining a position with a manufacturer, providing he desires to enter this phase of the work. The position of designing engineer with a signal manufacturer is one which must be filled by a man who is thoroughly trained. Most of these positions are filled by college men, and the man educated to be either an electrical or mechanical engineer has a splendid opportunity to qualify as a designing engineer after a little experience along this line. A few men who are not college-trained hold positions as designing signal engineers, but they are men of exceptional ability who have struggled to the uppermost heights of their profession.

To qualify for signal engineering a man should be technically inclined and above all should have a liking for railroad work. There is a lure to the railroads that affects many young men; and if those who feel this calling are at all inclined to be mechanical or electrical, then signal engineering is indeed a pleasant field to work in. A signal engineer spends a large part of his time out of doors and this makes for health and vigor. Good eyesight and color sight are absolutely essential for this work.

At a recent meeting of the Railway Signal Association the present shortage of signal engineers was discussed. During the past few years the railroads have found it utterly impossible to obtain properly trained men to carry on their signal installation and maintenance. This shortage exists at the present time and will continue to exist until enough men are trained in this unique but important branch of engineering. The need for men is growing every day; it must grow as the railroads are extended. The future of signal engineering is only limited by the railroads and there is no need for concern regarding the future of the railroads in this country. Many of the railroads of lesser importance do not have automatic signaling systems at present, but it is only a question of time before this system will be accorded universal adoption. Within the next few years many millions of dollars will be spent for signal equipment.

There is positively no opportunity for a man trained in signal engineering to go into business for himself unless he is able to invest his money in an established signal manufacturing company. There is no need for consulting engineers as each railroad employs its own experts. About the only way a man could get into business would be by inventing a new and practical signaling system and interesting capital in it. There is certainly plenty of room for improvement in signaling devices and a man in this field with inventive talent will have little trouble obtaining reward for any improvements he may devise. The railroads are always willing to pay handsomely for anything that will save life and property.

Considering the nature of the work and the amount of training necessary signal engineers are well paid. Men who have reached the upper regions of this profession find little trouble in obtaining salaries as high as $10,000 per year. From this point the salaries range down to $90 per month for beginners in the work. However, this salary is not any lower than a beginner's salary in any other field. Most of the college graduates in electrical engineering receive from $80 to $100 per month when they start in. The traveling signal man receives about $180 per month and to this is added a certain amount for expenses. Division signal engineers receive from $190 to $200 per month. The salary of an assistant supervisor is about $200 per month with all expenses paid. Supervisors generally receive from $215 to $225 per month exclusive of expenses. General inspectors are paid about $250 per month.

Signal engineers, like all other professional men, should have ambitions and ideals if they wish to progress in their field. Every man in this profession should strive to produce a greater safety of life and property and maintain the system under his jurisdiction in perfect order, which will bring about a minimum of suffering and minimum loss of property through wrecks. The casualties of every railroad depend largely upon the signal system. When signals go wrong, trains go wrong and this usually means a disastrous wreck with its consequent loss of life. Every signal man should be proud to feel that it is within his power to reduce the number of wrecks to a minimum in his position of guardian over the movement of trains on the great railroad systems of our country.

*IT was our recent good fortune to visit and study the switch and signal installation in the Grand Central Terminal. The occasion was when a French reader of the* SCIENTIFIC AMERICAN *was in New York City, as our guest, on a mission of studying manufacturing methods in general and switch and signal mechanisms in particular. Truly, the magnitude of a modern switch and signal installation is wonderful. At the New York Central terminal the trains come and go as though parts of a huge clockwork. In the switch towers the directors, as they are called, follow the movements of trains on an animated miniature of the track layout. Orders are issued by the director to a staff of operators who pull the various levers projecting out from a bank of cabinets. Little green lights indicate the position of any given switch or signal, and whether a track is clear or occupied. An impulse is returned by either switch or signal when its function has been fulfilled, thus conveying positive confirmation to the operator some distance away in the switch tower. Here, indeed, is by no means the least interesting of the many interesting phases of railroading, and Mr. Yates did well to choose this subject for the present instalment of his series dealing with opportunities in many fields.*—THE EDITOR.

### Electrified Milk

AN English scientist, Prof. J. Martin-Beattie, of the University of Liverpool, has made important discoveries in connection with the sterilization of raw milk. The common method in use in America and Europe to make milk safe is pasteurization. Pasteurization is absolutely effective, in that it kills all bacteria, but it can be said that it is not a perfect process, for the reason that it alters the taste of the milk. Pasteurized milk is not "raw" milk. The degree of heat and the mode of its application give pasteurized milk usually a flavor which is objectionable to many.

For several years Dr. Beattie and his associates have been experimenting with electricity as a substitute for pasteurization. They have perfected apparatus for running electric current through milk, and have determined the proper quantity to apply. The application of electricity is of very short duration. It does not raise the temperature of the milk to more than 148 degrees Fahrenheit. The milk is not "cooked," not altered in any essential properties through such heating as is incidental to the process.

# Solving the Labor Problem—III

## How Wages Were More than Adjusted to the Cost of Living, with Increased Output and Freedom from Strikes

By E. W. Hulet, Second Vice-President in Charge of Production, White Motor Co.

THE fact that an industrial concern, employing many thousands of men, has passed through the war and post-war periods without a single strike or any so-called labor trouble whatsoever, is of profound economic significance.

It will not be disputed that a satisfactory adjustment of the relations between the capitalist and labor is the biggest problem confronting the world today. This article is written in the belief that a discussion of the underlying principles and the methods by which the White Motor Company has so successfully solved its own problem under the trying conditions of the past six years, will prove to be of assistance to other establishments that are wrestling with the same problem.

We shall outline the underlying principles upon which our industrial relations system is based, and then pass on to consider the methods by which these principles have been applied.

### The Four Elements in Industrial Relationship

In the management of industry, there are four groups to consider: The stockholder who has money invested; the management who plan and direct; the workman who produces; and the public, which consumes. All four are entitled to and must be given their proper consideration.

Business was originally founded for service, and we are endeavoring to give service with proper relations and in proper proportion. Should any one of the above groups not receive its proper attention, the position of the other three would be jeopardized.

We need capital: the producer and the public will suffer if capital is not given its just return. We need the producer (the management and workmen being considered the "producer"): capital and the consumer will suffer if the producer is not properly considered. And likewise, both capital and producer will suffer if the consumer (the public) is not properly and justly dealt with. This is the old-fashioned principle which we are following.

We feel that our production problem is an industrial-relations problem. Maximum production cannot be had without proper industrial relations, and, with this in mind, we have been working for the past six years to build up a proper relation between management and men. Although in no way perfect, we feel that the better relations have helped to bring about the increase in production which is shown in the accompanying chart.

### Production Is the First Essential

Production is the first essential and of the most importance to industry. Everything must be working smoothly and properly in the factory if you expect production to run regularly, economically, and at its maximum: and to secure production, there must be high morale and the right mental attitude of men to their jobs and to the management, and of the management to the men.

High morale, the right mental attitude of men toward their jobs, means more to production than high speed. High morale has as its basis confidence in management and confidence in the industry. For the past six years our efforts have been directed toward the building of a solid foundation upon which high morale may thrive. We feel that confidence has been established by placing squarely before the employees, through our committees and the *White-Book*, our factory publication, the problems of the management.

**E. W. Hulet, Second Vice-President in charge of Production, White Motor Company, and author of this article**

### The Men Do Not Want to Manage

The workers do not want to manage. It is no part of their scheme of life. They do not want to share the great risks that are run in assuming the responsibility of management. They, the thinking workmen, will tell you that they have not the length and breadth of vision, the training or general knowledge which are necessary to make good managers. The great majority prefer to remain at their own work, for which they have been trained and fitted.

### Contact of Management and Men Through Shop Committees

With a view to bringing about a closer relationship between the management and its employees and to provide a medium through which may be transmitted the thought, feelings, requests and desires from employees to management and from management to employees, we have instituted what is known as "shop committees." Under this arrangement, each department of the works is divided into groups of approximately ten men and a representative is elected by each group. The employees elected by the various groups in one department form the Department Committee. Any employee of the department in which election is held is eligible to act as a committeeman, and the meetings are held biweekly by separate departments on the company's time, and they are so scheduled that only one committee meeting is held at a time. All committees are elected by secret ballot and the committees elect their own chairmen and secretary annually.

The manager and superintendent of the departments represented, with their assistants and general foreman, are privileged to attend the department meetings but are not considered members of the committee. The committee meetings are open forums where all questions of interest, whether pertaining to the factory or not, are freely discussed; questions pertaining to policy, production, expansion and any of the various activities of the factory are debated and graphically illustrated by representatives of the management. Minutes of the meetings and graphic and other charts which have been discussed are posted on the bulletin boards of the department locker rooms for the benefit of the employees.

This very simple form of committee system has been operating successfully in the factory for the past five years. By its means, employees are taught the necessity of production and the proper methods of securing it economically. They are taken fully into the confidence of the management and are given an insight into managerial problems, with every opportunity to follow them up in detail, and, if they so wish, to make suggestions. The "cards are put on the table," and the problems, as they confront the management from time to time, are discussed by a representative of the management at the committee meetings.

Any point deemed of interest may be brought before the committees by members for discussion; and if these are of a nature that would necessitate any great outlay of money or any radical departures from policies and practices, they are referred to the management. If they are considered to be practical and for the good of the industry, they are adopted. When a contrary decision is arrived at, the manager goes before one of the committees, informs them of the fact and discusses the reasons for his judgment.

*I am in a position to state that at no time has the ability of the manager to judge of such matters been questioned by the committees, and that at no time has the management been called upon to bargain with the men collectively for wages, hours or conditions.* The secret of this happy solution of the problem is found in

(*Continued on page 622*)

*AT the recent meeting of the Society of Industrial Engineers, the White Company was held out as a model in industrial relations. There can be no doubt that here is one large corporation that has been able to convince its workers that it is "on the level" in its dealings with them. Were this not the case, it would not have been possible to make the showing recorded in the table mentioned in the text, which we reproduce herewith:*

| Year | Factory Value of Product | Average No. Men | Estimated Buying Power of $1 | Average Weekly Earnings Based on 51 W'ks' Work | Hours Work | Hours Pay | Total Wages | Trucks Per Man Per Year | Factory Value of Trucks Produced Per Man Per Year |
|---|---|---|---|---|---|---|---|---|---|
| 1910 | $ 3,836,290 | 1,072 | | $14.04 | 60 | 60 | $ 767,496 | 2.290 | $3,578.63 |
| 1911 | 5,097,523 | 1,419 | | 12.82 | 59 | 60¼ | 927,696 | 1.985 | 3,592.33 |
| 1912 | 6,739,756 | 1,852 | | 13.53 | 59 | 61½ | 1,278,426 | 1.785 | 3,639.17 |
| 1913 | 6,795,196 | 1,964 | | 13.45 | 59 | 61½ | 1,347,064 | 1.785 | 3,459.87 |
| 1914 | 9,023,172 | 2,202 | $1.00 | 15.03 | 59 | 61½ | 1,688,467 | 1.924 | 4,097.72 |
| 1915 | 21,040,078 | 3,758 | .90 | 16.51 | 54½ | 59½ | 3,163,857 | 2.460 | 5,598.72 |
| 1916 | 17,053,311 | 3,611 | .86 | 17.34 | 54½ | 59½ | 3,186,921 | 2.082 | 4,722.60 |
| 1917 | 22,448,927 | 4,341 | .72 | 20.94 | 54½ | 59½ | 4,637,105 | 2.040 | 5,171.33 |
| 1918 | 30,952,748 | 4,844 | .55 | 27.07 | 54½ | 59½ | 6,688,051 | 2.720 | 6,389.91 |
| 1919 | 35,525,427 | 5,468 | .50 | 31.73 | 49½ | 52 | 8,849,322 | 2.766 | 6,496.98 |

*The factory value of the products includes merchandise and supplies, labor, power and fuel, maintenance and repairs, factory salaries and general administrative expense, insurance, taxes of all descriptions, plant extension costs and dividends. The average value per truck on this basis is $2,347; the increase in price since 1914 is approximately ten per cent. The White people attribute the showing to the provision of ample capital and plant and the use of sound methods of manufacture, to management, and to the voluntary giving by the men of an honest day's work.*—THE EDITOR.

*Left:* Tractor and four-horse team drilling winter wheat in the same field. The tractor hauls two seven-foot drills and the horses one. *Right:* Plowing a hillside farm near Delhi, N. Y., with a reversible plow

**Two exhibits to deny that the horse is altogether a back number on the modern farm**

# The Farm Tractor in 1920

## An Effort to Reconcile Conflicting Views and State the True Rôle of the Mechanical Horse

By Francis Z. Hazlett

A RECENT report of an interview with a man who by virtue of the office he holds should be well posted on all the uses to which the internal combustion engine is being put, contained the statement: "Tractors and other gas engines have almost entirely replaced other methods on the farm." This man was probably city-born and bred—possibly one who never in his life stayed on a farm overnight. But if he will take the trouble to look over into the fields next time he takes a drive in his auto, or if he will look out of the window for a few minutes while passing through the rural districts next time he takes a trip on the train, he will very likely see quite a lot of "other methods."

Only a few days later another man, who likewise ought to be up to the minute on farming methods and the needs of farmers, told me that in his opinion there are just three reasons why a farmer should own a tractor. He said: "In the first place, if you own a tractor, your neighbors and the people you know in town will consider you a progressive and up-to-date farmer. Second, if you buy a tractor you can keep the boy on the farm one year longer. He will stay with you the year the tractor is new, but will leave the next year. Third, a tractor may enable you to get your plowing done a little more quickly."

Which man was the farthest astray in his remarks? Ask the next dozen people you see who have given any thought to the subject and the chances are you will have a dozen more different opinions on what the tractor has done and can do for the farmers. You will find the man who thinks that inventive genius and industry by providing the tractor have rescued the farmer from endless toil. You will find the man who classes the tractor with the time-honored gold brick and bogus mining stock—just another means of getting his hard-earned money away from the simple tiller of the soil. You will find the man who cannot understand why the cheap and efficient tractor has not lowered the cost of food. Then there is the man who intends to buy a big tract of cheap land and a fleet of tractors and retire on his first year's earnings; the man who says a tractor may be all right for a rich fellow who keeps a farm to spend his money on; the one who thinks that farm tractors won the war; and the one who considers that the tractor is still in the experimental stage, like commercial airplaning or wireless telephony or colored movies.

Gas tractors first came into general use ten or twelve years ago in the northern part of the Great Plains. Great areas of new land were being opened up for settlement and millions of acres of prairie were being put into crops. Horses were scarce and high priced in this territory, little feed was available, and plowing virgin prairie with them was tedious work.

The gas tractors which were then being made were capable of pulling from six to a dozen plows and offered a means of putting this land under cultivation at a rapid rate. The returns from a large acreage of wheat or flax were so great that the farmers were willing to invest a considerable amount of capital in an effort to make a winning, and thousands of them borrowed money with which to buy tractors. However, the machines were crude, the owners often knew little or nothing about keeping them in repair, they were almost invariably overloaded, some of the manufacturers made little effort to supply the users with repairs and as a result many of these tractors which had been bought at great expense were sent to the junk heap. Most of the owners were convinced that the tractor was unprofitable for farm work, and such of them as were not broke or entirely disgusted with farming went back to doing their work with horses.

These first gas tractors resembled the tractors of today just about as much as the first "horseless carriage" resembles the 1920 automobile. Apparently 1905 is the year when a gas tractor designed to furnish power for plowing was first placed on the market. This machine had a double-cylinder engine, used gasoline for fuel and oil for cooling. It was rated at 22 nominal and 40 actual brake horse-power, and was capable of pulling six to eight 12-inch plows, depending on the soil. It was built to look as much as possible like a steam tractor engine and it weighed 9½ tons.

This was just at the time when automobiles and motor trucks were getting their start and manufacturing circles were alive to the possibilities attending the development of a successful farm tractor. By 1909 there were forty or fifty firms and individuals making or attempting to make tractors. Naturally many of these machines were mere makeshifts, for the manufacturers recognized the advantages of getting in on the ground floor of an industry in the making. At best they were heavy, rough affairs, put on the market without a thorough trial by the manufacturers, and when they were tried by farmers they were found wanting in many respects. Buyers of these early tractors found them unprofitable and unreliable, and the whole idea of mechanical power for farm work was given a serious set-back in the minds of farmers.

Manufacturers realized that if the industry was to prosper better machines would have to be built; that they would have to be capable of doing something besides plowing; and that they must be adapted to a

*Left:* An abandoned tractor on a wheat farm near Salina, Kan. Salvage values appear to mean as little to the tractor farmer as they did to his horse-using predecessor. *Right:* A ten-twenty horse-power tractor running a separator on an Iowa farm

**Two tractors of widely divergent model, and the divergent fates that awaited them**

wider range of conditions than those which obtained in the bonanza wheat fields of the Great Plains.

It was apparent that these first tractors were too large to be used anywhere except on the big level farms of the prairies, and consequently small machines were built. Today, a large percentage of the tractors being manufactured are designed to pull either 2, 3 or 4 plows. There are probably more two and three-plow tractors in use now than all other sizes combined. From the rough machines of poor design, with crude engines, excessive weight, cast gears and exposed working parts, have been developed compact, well-designed machines with cut and hardened gears, efficient driving mechanisms, radiator cooling systems, enclosed and lubricated working parts, kerosene carburetors and air cleaners. The modern tractor can be handled by one man and is light enough and versatile enough to be used for a great variety of farm work. It is invariably equipped with a belt pulley and is used for all kinds of belt work. There are now at least 100 firms actually engaged in the manufacture of tractors and probably twice that many more who are planning to begin in the near future.

The manufacturers endeavor in every way possible to insure that the purchaser of a tractor will be successful with it. Every year the progressive manufacturer holds tractor schools in all the places where his machines are used in any number. Owners of his machines and in fact anyone who is interested can attend these schools, which may last from two days to two weeks, and learn from experts how to operate and care for the tractor. Most of the State colleges of agriculture give similar short courses in "tractioneering." But even with these great advances, farmers have not "taken to" tractors to the extent which many people profess to believe.

There can be no doubt but that the tractor is a boon to thousands of farmers in these days of scarce, poor and high-priced help, but it is only beginning to make its influence felt on farming in general. When we entered the World War there were probably not more than 40,000 tractors in use in the whole country, and there are more than six million farms—only one tractor for every 150 farms. The number has increased until there were probably 350,000 machines used on this year's crops.

There are some tractors in every State in the Union, but just how many there are in each State and just what kind of farms they are on, no one will know exactly until the returns of the Agricultural Census are completed.

Illinois is generally purported to have more tractors than any other State, but the census may put Iowa, Kansas, South Dakota or Nebraska in the lead. The Kansas State Board of Agriculture has collected data showing the number of tractors in use in the State during each of the past five years. In 1915 there were 2,493 tractors; in 1916, 3,932; in 1917, 4,504; in 1918, 5,415; and in 1919 there were 8,609.

There are eight to ten times as many tractors in the whole country now as there were three years ago, but the ownership of a tractor is still the exception rather than the rule among farmers. And as yet very few farmers agree with the enthusiast who sees a tractor on every farm within the next five years and who imagines that all farm work could be done better, more quickly and more economically with mechanical power than in any other way. On the other hand we would have a hard time finding a real live farmer who concurs exactly with my friend and his "just three reasons." The use of tractors will certainly continue to increase, but the farmer, instead of having been anxiously awaiting a mechancal power plant, must, like any other business man, be convinced that something better than his old method has been produced.

The farmer took to the automobile just as readily as did the city man when he was convinced that it would meet his needs, and today there are more automobiles per capita among the rural population than there are in the cities. Similarly, farmers are buying tractors just as fast as they are being convinced that tractors are needed in their business. It is said that more than half the farms in the country are less than 100 acres in size, and probably 90 per cent of the tractors now in use are on farms larger than this. The principal advantage of a tractor is in saving man labor and in doing work which could not be done by other methods. If the man on the small farm can do most of his work himself and can get it done in good season by using the old methods, it is difficult for him to see how a tractor costing from $1,000 to $2,000 would be a paying investment. Except for the saving in man labor, the cost of doing field work with a tractor is probably no less than that of doing it with horses, and on these small farms it will usually be cheaper to hire belt work, such as thrashing and silo-filling, done than to own a tractor and machinery for doing it. It seems now that unless conditions change radically these small farmers, if they expect to use mechanical power economically, must purchase tractors coöperatively, and make each tractor do the work on two or three farms.

The operators of larger farms where there is plenty of work to make tractors profitable quite generally realize the advantages of the tractor, and the only thing which has kept many of them from adding these machines to their farm equipment is that all their ready money has been needed in other places. With the high price and scarcity of farm help, however, many are being practically compelled to buy tractors in order to get their crops planted.

Some are not yet convinced that tractors are reliable, and there are some who do not think themselves capable of operating a tractor successfully. Still others on account of sentiment or ultra-conservatism do not like mechanical power at all and predict the disappearance of tractors from our farms. It is probable that many such men, even though their farms are well suited to the use of tractors, will never own them. Advocates of this belief point out that the tractor, producing no manure and consuming something of which the farmer can grow no part, must revolutionize the entire economics of farming if it is to succeed. Then they assume that this revolution cannot be effected, and argue that therefore the tractor must fail.

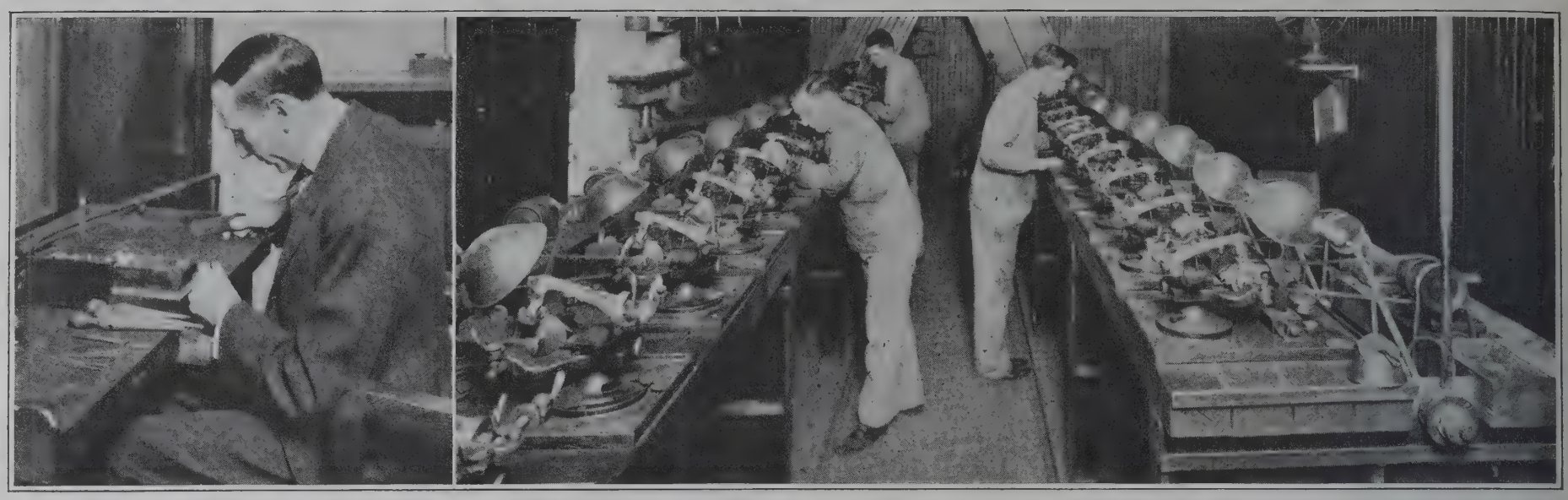
As a general rule the tractor is used to supplement the horse-power already on the farm and most farmers who own tractors still keep a part of their horses. Investigations by the Department of Agriculture and the State Colleges of Agriculture show that farmers who now own tractors have not disposed of more than 20 or 25 per cent of their horses on the average. A survey by the Federal Office of Farm Management of corn-belt farms where tractors are owned showed that on most of the farms horses still do a larger percentage of the work than tractors. If a tractor enables a farmer to get his rush work done in better time, of if it makes him independent of hired help or enables him to enlarge his farm, he usually finds that it is a profitable investment, even though he still keeps horses for work to which the tractor is unadapted.

Another typical case where the tractor can hardly compete with the horse is found on the one-man cotton farm. Here the peak of the season's work is not encountered at plowing time at all, but rather at harvesting time. The tractor cannot be used in picking the cotton, and the farmer can plant and cultivate with a horse as much cotton as he can ever pick. So why should he buy a tractor?

According to the reports of the Bureau of Crop Estimates there were still 26,100,000 head of horses and mules on farms at the beginning of the present year. While there was a decrease of 359,000 head during 1919, this represents only about two head for each tractor which was purchased during the year. It must be remembered, however, that the entire reduction is not due to the increased use of tractors. Automobiles and motor trucks are also factors in horse displacement. At least 50,000 farmers have added motor trucks to their equipment during the last three or four years, and the number who own automobiles has been estimated at more than 2,000,000.

1. Fall plowing of sweet clover after heavy pasturing (Rochelle, Ill.) 2. Seeding winter wheat with an 18-disk, six-foot drill (Warrensburg, Ill.) 3. Harvesting wheat with tractor and binder in Indiana. 4. Tractor pulling eight-foot culti-packer (Macon, Ga.) 5. Corn binder drawn by tractor (Marion, Ind.)

**A general indication of the variety of field work of which the tractor is capable**



*Left:* Cleaver splitting the rough diamond preparatory to cutting. This calls for long experience and remarkable skill, since a slip of the tool means a very material loss in the value of the fragments. *Right:* The sawing room, where the dividing of a large stone is carried on with absolute precision, as contrasted with the cleaving method

**Two ways in which rough stones are divided up into a number of smaller stones, preparatory to cutting**

# Our Diamond Industry

## How the United States Has Become the Greatest Buyer of Diamonds in the World

By Harry A. Mount

AMERICA is the greatest diamond-consuming nation in the world. Not only do we buy more diamonds than any other people, but we buy the finest diamonds the world's markets afford. It is not surprising, then, that around this traffic has grown a curious miniature industry, whose product is of national importance.

Our diamond industry centers in New York, principally because diamonds and workmen alike have been imported through this port. There is in New York a distinct "diamond district," just above the city's famous financial district. Hundreds of firms and thousands of individual dealers have their offices in this district, and here also are most of the important diamond-cutting plants. Nearly every diamond in this country has passed through the hands of dealers and workmen in this "diamond district."

The diamond district has taken on some of the airs of its neighbor, the financial district, for there are not only brokers, large and small, but a full-fledged curb market where the lesser tradesmen barter among themselves.

Every building in the vicinity of Maiden Lane, John and Nassau Streets has its share of diamond dealers, diamond brokers, diamond cutters, and setters. One skyscraper building is occupied exclusively by diamond interests and diamond jewelry manufacturers.

The curb market, perhaps the most picturesque feature of the diamond district, is at the corner of John and Nassau Streets, where at any time of the year and at any time of the day a group of a hundred or more men can be found standing about, apparently idling away their time, occasionally examining a paper of diamonds under a jeweler's glass. These men are all recognized diamond merchants and deal chiefly among themselves. Many of them have made a section of this curb their office for thirty years or more. While it is impossible to obtain any figures on the amount of business transacted on the curb it is estimated at several millions a year. And this represents just the "tag ends" of the total business done in the diamond district.

Once all the diamonds imported into this country were cut in Holland or Belgium. Fifty years ago a Hollander named Hermann opened a diamond-cutting establishment in New York, but he did only repair work and recutting. There was another small establishment in Boston. From these small beginnings the cutting industry has grown in this country until about a thousand men are now engaged at it and they cut a good portion of the large stones sold here. Because of the high wages paid, however, nothing but stones of considerable value, where the cutting cost is comparatively small, are cut here. But the workmen are the finest in the world, and it is not infrequent that a fine stone already cut in Europe is recut here because of the superior workmanship.

The whole diamond industry is so intertwined with European connections that it is well to recall here, briefly, the system which controls the world's diamond trade.

It is a well-known fact that the mines of South Africa supply nearly all of the diamonds of commerce. India was once the chief source of supply and a few still come from there. A few diamonds are found in Brazil, but there are not sufficient numbers of diamonds found outside of Africa to influence the market. The South African production is controlled by a British syndicate, which thus controls 90 per cent of the world's production, and this syndicate, please take note, carefully manipulates the supply so that it is always a little in arrears of the demand.

It is a rarely accorded privilege to be able to buy direct from the syndicate. Once a buyer is on the syndicate's "list" all he can do is to apply for a "shipment" and await his turn to buy. He is required to fill out an application blank setting forth exactly the character of the goods he wants. He is finally notified that a "sight" of the diamonds will be ready for him on a certain date. It is his privilege, then, to inspect the diamonds and refuse them if he likes. But the privilege of a "sight" is very rarely exercised. If a man rejects a shipment he is penalized by being skipped once or twice when his turn again comes around, or may even be removed from the list. Experienced buyers always take what the syndicate selects for them. Diamonds are apportioned to the different sections of the world according to local demand for color, perfection, size and the like, and since America demands the best qualities the mines produce her buyers usually get the best.

Now most of the buyers on the syndicate's list were formerly in Amsterdam or Antwerp, and in establishing an American cutting industry some difficulty was encountered, not only in finding competent workmen, but in getting buyers "on the list." The process of

(*Continued on page 623*)

*Left:* The setter, shown at the left, adjusts the diamond in the holder for the polishers at the right. Polishing is done by means of close-grained semi-steel disks the working surface of which is impregnated with a mixture of oil and diamond dust. The stones are held against the revolving disk. *Right:* Cutting the rough stones, so as to give them their form

**Two stages in the conversion of a rough, sparkless bit of crystal rock into a brilliant diamond**

## How a Little Ingenuity Retrieved a Broken Drill Set

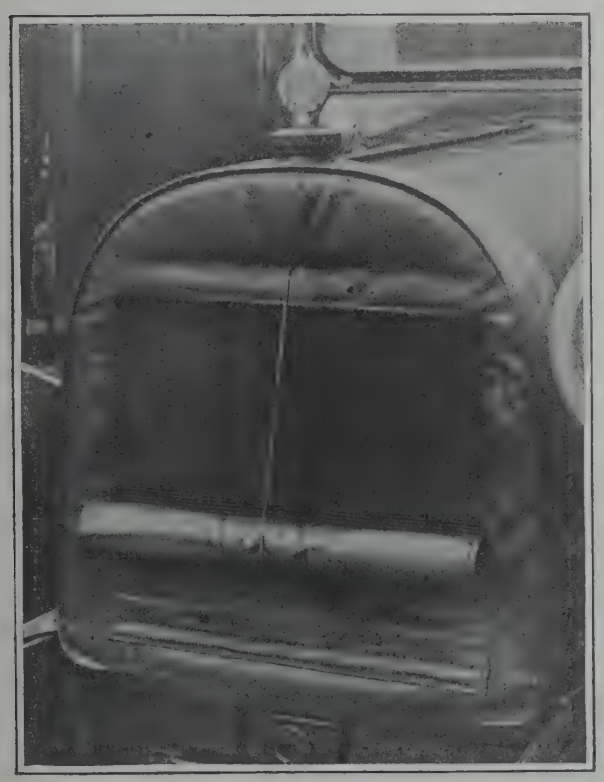
WHILE drilling a well in granite at a depth of 70 feet, the drill bit broke. The hole was 5¾ inches in diameter and the recovery of the broken bit—a portion measuring about five inches—presented quite a problem. After several attempts a piece of iron was forged with malleable prongs and fastened to a steel rope. The malleable prongs were driven down with such force that they were bent entirely around the broken bit, and raising the prongs and bit to the surface was quite a simple task.—By *R. Franklin Mundorff.*

## Rails Tested by Magnetic Analysis

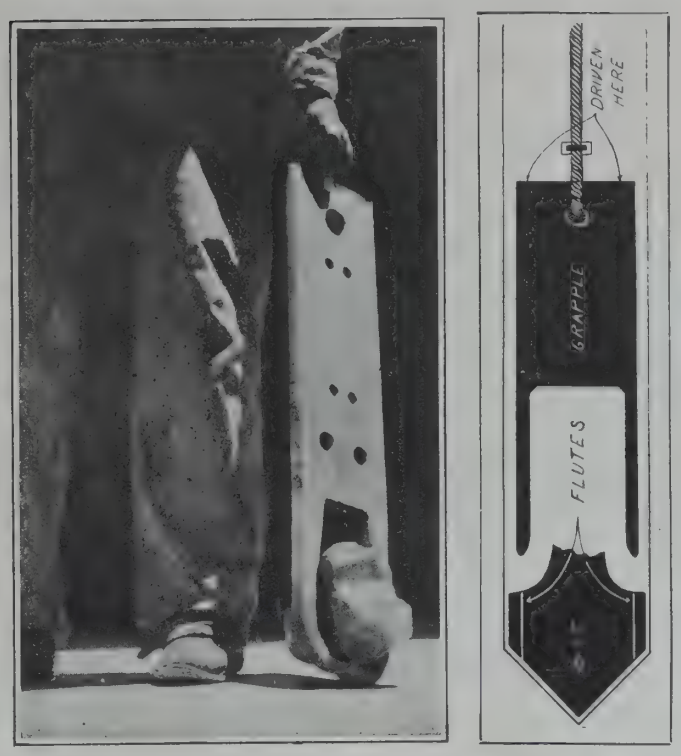
THE new method of testing steel by magnetic analysis possesses advantages which render it interesting, as a non-destructive means of testing, to supplement tests already in use. Magnetic analysis enables one to detect structural changes due to heating or cooling, or as an indication of mechanical properties; for the mechanical properties of steel are functions of its chemical composition and of its micro-structural and mechanical conditions. The micro-structure and mechanical conditions with regard to internal strains are determined by the heat treatment and the amount and kind of work to which the piece has been subjected. The magnetic properties of steel are also functions of the same variables, and any change produced in one set of properties is accompanied by a corresponding change in the other. The magnetic laboratory of the U. S. Bureau of Standards has developed a method for determining the degree of magnetic uniformity along the length of specimen of substantially uniform cross-section, the method being particularly applicable to steel rails. The test consists in surrounding the rail with a magnetizing solenoid, which is run along the rail. A sensitive electrical instrument, which is connected to a test coil carried with the solenoid, indicates any change in magnetic permeability as the coil is moved along. A method is being developed for testing ball-bearing races on these lines, and experience already gained has furnished sufficient evidence to warrant the conclusion that magnetic methods may be used to advantage in fundamental investigation and for non-destructive testing of steel products. To apply the magnetic test to a forging before machining might save the labor of machining a defective forging.

## A Radiator Flap that Unrolls Itself

THE motor car driver can now sit in his car and adjust the radiator cover flap without getting out. This new accessory is so made that it rolls itself when the driver pulls a string. When the control cord is pulled the flap unrolls upwardly. When let out it rolls itself at the bottom of the radiator shutters. The explanation for this is that highly tempered steel springs are made into the flap itself. On the dash of the cord is a cord holder, and a cord guide which guides the cord as it is pulled.—By *K. H. Hamilton.*



**This radiator cover flap is controlled from the driver's seat by a simple cord**




**Special iron forging with malleable prongs bent about the broken drill bit, and how the bit was retrieved**

## James Means, Aviation Pioneer

THERE died in Boston on December 3rd James Means, who was largely responsible for the interest of the Wrights in flying. He founded and for several years in the 90's published the *Aeronautical Annual*, in which he made it his business to set forth his ideas with regard to the possibilities of aviation. A regular contributor to his columns was Langley; and it was through their reading of Means' publication that the Wright brothers, according to a speech by Orville in Boston in 1916, were drawn into the design and construction of planes.

## Musical Pitchforks in South Africa

A TALE comes out of England which illustrates admirably the sort of unexpected demand which may have to be met in building up a foreign trade. A British manufacturer of edge tools made up his mind to secure a share of the trade in Kaffir picks, and obtained a sample of the native-made pick, which he reproduced so exactly that it seemed to be impossible to detect the difference between it and the native article. His tools, however, did not sell, and a representative was sent out to investigate. He found there was one thing for which the Kaffir used the pick that had not been taken into consideration. The native took it out of its haft and used it as a cattle call, and every Kaffir had found that the British-made pick had not quite the right note. It speaks well for the enterprise of the maker that, having discovered this, he produced a Kaffir pick with the right note and established a trade which, the story goes, he has retained ever since.

## A Leadless Insect Spray

THE recent discovery of a lead substitute for the making of insecticides, as disclosed at the convention of the American Chemical Society in St. Louis, is anticipated as being responsible for the saving of millions of dollars of farm products. Credit for devising a method of preparing a commercial grade of calcium arsenate belongs to the scientists of the Insecticide and Fungicide Board, U. S. Department of Agriculture.

The use of calcium arsenate as a substitute for lead arsenate is a notable contribution to the industry of manufacturing insecticides because of the cheapness of lime as compared with lead oxide. Of course, calcium arsenate cannot be sprayed alone on tender foliage but when combined with sulfides its application in fighting crop pests is effective.

The method of making calcium arsenate from lime and arsenic acid is prescribed as follows by the Insecticide and Fungicide Board: Obtain a good quality of lime, slake the product to as smooth a paste as feasible, for such a procedure not only determines the smoothness of the finished product but the willingness with which the lime and acid react. Apply from 3 to 3½ times as much water, by weight, as lime, and have the water warm. After standing for a while mix thoroughly, then adding twice as much hot water as used for slaking, mixing the products again.

Add the acid, at room temperature, to the lime without delay, stirring the ingredients well. Crush in a disintegrator or grind if advisable. In order to produce 100 pounds of a commercial grade of calcium arsenate it will require approximately 50 pounds of high grade lime to be slaked with 18 gallons of water, and then 45 gallons of a solution containing one pound of arsenic pentoxide ($As_2 O_5$) per gallon.

Preliminary experiments led to the belief that calcium arsenate might be manufactured directly from limestone, instead of from lime, thus eliminating the expense of burning. However, subsequent tests showed that the chemical properties were not such as to make a suitable product. And, furthermore, there seemed to be no advantage in attempting to substitute limestone for lime; hence the process as outlined above is the one recommended by the Department of Agriculture.

The calcium arsenate as a substitute for lead arsenate is capable of yielding excellent results on resisting plants in the warfare to conquer crop pests. The Department of Agriculture enumerated the following as some of the virtues of an effective arsenical spray:

The absence of an excessive quantity of soluble arsenic, which would result in injury to foliage; manufactured in fine particles that it may be evenly distributed over the foliage; light in form when dry, thus affording easy application by dusting; it should suspend well in water, thus permitting of even distribution when administered in the form of a spray; and when sprayed and subsequently dried should cleave to the plants. On this showing it is plain enough that there is no occasion to cling to the established lead-bearing sprays.

## Tapping the Trolley Wire Without Stopping the Trolley Cars

THE accompanying illustration depicts the method employed by the United Railroads of San Francisco in taking current from the trolley wire without the necessity of removing the device each time a trolley car passes.

Current from the usual trolley wire is often used to operate machines such as air compressors, concrete mixers, banks of camps, and so on, and it is important that the machines or equipment be operated continuously. With the old method it was necessary to remove the device each time a street car passed; but with the new device the passing of street cars does not interfere with the taking of current for operating the machines. In other words, the current-tapping member does not interfere with the passage of the trolley wheel.

The device is supported on a column that stands at one side of the track a sufficient distance away to enable a car to pass. From this column the arm extends out to the trolley wire, and is held tight against the upper part of the trolley wire by means of a rope. The device can be set up or taken down in a minute.—By *C. W. Geiger.*

**A trolley-wire tapping device which does not interfere with the passage of the trolley wheels**

# The Service of the Chemist

*A Department Devoted to Progress in the Field of Applied Chemistry*

Conducted by H. E. HOWE, Chemical Engineer

## Electrical Production of Alloys

IN a paper before the American Electro Chemical Society, Ralph M. Major discussed the electric production of alloys, pointing out that some of the advantages in melting in an electric furnace are as follows: First, a higher temperature is produced than can be obtained in any other furnace and at the same time this may be controlled. This results in a more rapid melting of the charge and the ability to tap superheated metal, thus allowing time to add deoxidizers and giving the impurities a chance to rise into the slag while the metal cools only enough to bring it to the proper pouring temperature. It is recognized that the requirements upon the refractories are extremely hard. Another advantage is that the atmosphere in which the melting takes place is more nearly non-oxidizing, permitting a greater saving of valuable additive materials such as manganese. Finally, a better quality and more nearly perfect homogeneity of product is possible when using an electric furnace than in any other way.

## Case Hardening of Commercial Steels

A CHART has been prepared by H. B. Knowlton for the heat treatment of four types of steel, which should be very useful. The steels covered are carbon, nickel, chrome nickel, and chrome vanadium. The temperatures and directions for quenching, reheating, cooling, etc., are given. The four treatments are divided as follows: Treatment No. 1 gives a steel that is case hard but brittle, with a strong core but not a tough one and it will not stand shock very well. It is the cheapest treatment and should only be used where great toughness is not required. The second treatment produces case hardness somewhat refined. The extreme outside may be brittle and chip off, and while the steel will stand considerable shock without breaking, the core is soft, coarse-grained, and neither strengthened nor toughened.

The third treatment is applicable only where the carbonizing temperature is accurately controlled and it may cause bad distortion on some parts. The steel so treated is not liable to chip. The core is strengthened and toughened and the steel will resist shock well. The fourth treatment outlined is the best, causing less distortion than No. 3 and is recommended where maximum hardness, strength, and toughness are necessary. The steel is not liable to chip, will stand shock well and has a core both strengthened and toughened. An example of this fourth treatment may be given for carbon steel having carbon .15 to .25. Carbonize 1,600° to 1,700°F., cool in boxes, reheat to 1,600°F., quench in oil, reheat to 1,400°F. and quench in water or reheat to 1,440°F. and quench in oil. The temperatures of carbonizing given assume that a first-class compound will be used and all reheating should be done in lead pots, salt pots, or in small furnaces where the temperatures can be accurately controlled.

## Natural Purple Dye

IN the *Color Trade Journal* for May, it is noted that a shell-fish exists on the Pacific coast of Costa Rica from which an especially fine purple color is obtained and used for the dyeing of silk thread. It is probable that this is the same dyestuff used by the ancients under the name Tyrian Purple, which has been discussed previously in these columns. The method of obtaining the coloring material differs from that employed along the Mediterranean, for it is stated that in Costa Rica the person who picks up the shell-fish merely blows his breath over it whereupon a few drops of greenish liquor ooze out. The silk thread when passed through this liquor and subsequently exposed to sunlight takes on a fast beautiful color without further treatment.

## The Uses of Boric Acid

BORIC acid and sodium tetraborate, the chemical name of ordinary borax, are the most important derivatives of the element boron. The largest use for borax is in making enamel coatings for wire and steel ware. It also finds large application in the glass industry, in the laundry, and the kitchen. It is a convenient water softener and is sometimes found in starches designed to give a high gloss. It is used as a coating for book paper and playing cards, and, as a solvent for shellac, finds extensive application in the hat trade. In tanning, both borax and boric acid are used for cleaning hides and dressing the leather. In the textile industry borax assists in dyeing, and in some parts of the world boric acid is still employed in the preservation of foods. It is permitted in the salting of fish because such foods are soaked in water before cooking and most of the boric acid removed. Being an antiseptic, boric acid is employed for external washes and it finds a place in cosmetics. It is used as a larvacide where it is recommended for the destruction of fly larvæ in manures, for it destroys the larva without affecting the bacteria which increase the fertilizer value of the manure. Finally, borax is a well-known flux used in metal working.

## Synthetic Rubber

THE methods employed in Germany for the production of synthetic rubber had been fairly well known for some time previous to the war, when the comparatively low price of natural rubber—a little over 70 cents per pound—made it unprofitable to compete with it. During the war, when price was not a consideration, the industry was expanded, the raw materials being acetone and aluminum. Acetone was secured from acetylene by a process similar to that employed at Shawinigan Falls. However, synthetic rubber could not be vulcanized and therefore was useful only as hard rubber. The natural rubber was mixed with synthetic rubber in order to produce the soft material needed for so many important purposes.

## Cooking Oils

FAT used for deep frying must have a high smoking temperature and the smoke when produced must not be irritating to the eyes or nose and must increase slowly as the temperature is raised. While standardized methods for determining these characteristics have not been provided, some of the results published indicate that the hydrogenated vegetable oils as a rule have a higher smoking temperature than animal fats. The smoking temperature is believed to be the temperature of decomposition, and if this is true the animal fats decompose more readily and extensively than do the hydrogenated vegetable oils, becoming rancid earlier and not capable of being used so long. Nearly all the fats and oils used in the kitchen have smoking temperatures near 200°C.

## Analysis of Sole Leather

IN *Le Cuir* there is a discussion of the analysis of sole leather with the determination of the water soluble material by the English and French methods. It seems that all physical properties yield data valuable in determining the grade of such leather, including resistance to cutting, compactness of fibers, the color of the cross section, and even the odor, taste, and color. There is apparent need for uniformity in methods, since the two under discussion gave decidedly different results, the English giving the higher values. By this method a sample is first cut and then ground in a suitable mill. Grease is removed from a 25-gram sample by extracting for 6 hours with petroleum ether boiling between 40 and 60 degrees. The solvent is then allowed to evaporate, the leather being spread on a plate in a warm place over night. It is then placed in a Procter extractor, covered with water, and allowed to stand over night, and the next day is heated to 45 degrees at a rate to produce 1 liter of extract in 3 hours. The extract is now filtered through good paper, the first 200 cc. being rejected, and 50 cc. of the clear filtrate evaporated to dryness in a water bath, dried in a vacuum oven, and weighed.

## Cottonseed Meal as a Human Food

IN the *Cotton Oil Press* for May, J. E. Halligan discusses the possibility of cottonseed meal as a source of human food. Since 1905 the meal has been used to a limited extent as a human food in Texas, where the meal has been specially prepared by eliminating the hulls and then grinding the meat to a fine powder. When properly prepared, the flour has a bright yellow color, a sweetish taste, and an agreeable odor similar to that of nuts. If the meal has been extracted and all traces of the solvent removed it is somewhat more attractive.

The high protein content, 43 per cent in meal and 50 per cent in cottonseed flour, at once suggests the possibility of using such meal as a meat substitute. This should interest those who find meat somewhat too expensive, since it is a question whether certain classes of workers now eat enough meat at present prices to satisfy their body requirements for protein. According to some of the authorities, 125 grams of protein are required per day for moderate work by the adult man, yet in some families in our cities this is known to fall as low as 80 grams per day, while in other countries statistics show an even smaller consumption.

Another consideration in favor of cottonseed meal and flour is the ease with which it can be kept indefinitely in dry storage in perfect condition without refrigeration. The bakeries have shown that cottonseed flour and meal may be used in nearly all products ordinarily made from other flours, though the products are richer in protein and fat since cottonseed flour contains five times the protein and ten times the fat of wheat flour, and six times as much protein and four times as much fat as cornmeal. Of course, cottonseed meal products may not agree with some individuals, but this is also true of other foods and every man must learn from his own experience the foods which best agree with him. It would seem that under present economic conditions there would be many interested in at least trying this source of the protein, fat, and mineral elements in the diet.

## Edible Lactic Acid

UNTIL recently edible lactic acid was not an article of commerce because no way had been found to produce it in competition with inexpensive citric and tartaric acid. Today refined edible lactic acid, 56 per cent by volume and 50 per cent by weight, sells around 35 cents a pound; whereas, citric is $1 and tartaric acid about 80 cents.

Within a year this edible lactic acid has been introduced in large quantities to beverage manufacturers, it having been found that the addition of a small quantity to beers of very low alcohol content greatly improves them by combining with the amides and amino acids which are present. As an acid for most of the soft drinks it is gradually replacing citric and tartaric acids, where 1¾ pounds replace 1 pound of citric crystals and 1½ pounds replace 1 pound of tartaric acid. Such lactic acid also finds use in the baking industry, in candy, production of jellies, and in the canning industry where the use of a small percentage of acid of this type facilitates the preservation of meats and fish.

## Our Sugar Supply

SO long as sugar remains difficult to get even at prices that seem unreasonable to us, we can find much of interest in the subject. The sources of supply for the United States during 1919 were as follows:

| | Tons |
|---|---|
| Cuban cane | 2,067,051 |
| From the beet crop of the United States | 872,253 |
| From Hawaii | 514,824 |
| Porto Rico | 286,880 |
| Louisiana and Texas | 154,034 |
| The Philippines | 72,511 |
| St. Croix | 8,286 |

and from maple and sugars from molasses, 34,094 tons. Full duty-paying foreign sugar from miscellaneous sources supplied 57,738 tons, making a grand total of 4,067,671 tons.

This consumption is the highest recorded for any country. Whereas, our great grandfathers consumed about 8 pounds per capita yearly, we reached 85 pounds last year, having gradually increased to that amount from 23 pounds in 1850. It is estimated that in 1920 the consumption for all purposes in the United States will average 90 pounds per capita.

Two statistical items will indicate another cause for the shortage. In 1914 the world's crop was estimated at 19,000,000 tons, of which 9,000,000 tons were derived from sugar beets. In 1919 the total production was 16,000,000 tons, of which only 4,000,000 tons were from beets. The chemist is doing what he can to assist by providing high grade maltose and glucose, but it would seem that we can expect little relief until the beet fields of Europe again become productive after their recovery from the war.

# The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

*This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles*

**Special body designed for the effective handling of plate glass**

## Special Truck Body for Plate Glass Transportation

LARGE sheets of plate glass for modern store fronts are believed to be one of the most fragile of commodities now hauled successfully by motor truck. The adaptation of the motor truck to glass carrying is a problem that has long puzzled body builders as the main difficulty has been in the construction of a satisfactory body to get the floor low enough without underslinging the frame. Manufacturers of plate glass who have tried the underslinging methods state that it has many draw-backs. A Chicago dealer in plate glass has worked out a successful glass carrying truck body that has been mounted on a standard truck chassis and which is shown in the accompanying illustration. It is stated that this body has met every requirement exacted by the great bulk, awkward shape and extreme fragility of plate glass. The height of the floor from the ground is just the normal

(*Continued on page 624*)

## Sand Boxes For Trucks

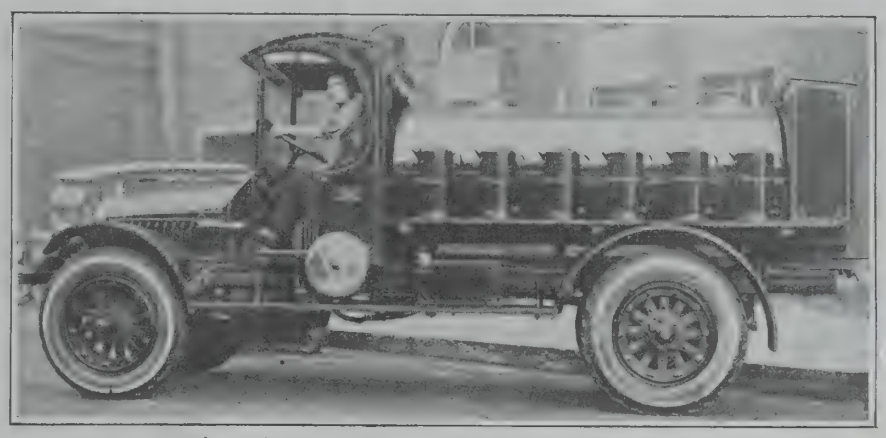
IT is not always possible to operate a truck fitted with traction devices as in some cities regulations have been passed prohibiting the use of any device that may damage the paving of the streets. When the highways are covered with snow and ice the devices can be used advantageously and without breaking the law because they do not come in direct contact with the pavement. There are many conditions, however, where traction is not good and yet the conditions are not severe enough to warrant the use of special traction grips, non-skid chains and similar devices. One of the important adjuncts to trolley cars and railway locomotives is the sandbox, this making it possible to drop sand on the slippery rails and secure traction until the train or car has started. The sand supply is called upon wherever there is a stretch of slippery rails. The owner of a large moving van has fitted his truck with sand boxes and has found them to be of considerable value when the truck is being operated on slippery streets. The discharge of the sand boxes is immediately in front of each rear wheel and is controlled by the driver. When sand is desired a simple control lever opens four discharge nozzles in each sand box and sand is distributed over the ground for a space corresponding to and slightly greater than the width of the tire. This suggestion should be a valuable one to truck operators as the scheme is effective and may be easily applied to any form of truck using solid rubber tires. The sand is not needed as much on pneumatic tire trucks because the modern cord tires made for truck uses are provided with a special tread which gives good traction under practically all road conditions.

**Sand box arranged at the rear wheel for better traction on wet and icy pavements**

## Mobile Concrete Mixing Plant

THE accompanying photographs show a concrete mixing plant mounted on an automobile truck. This plant was developed by the New York Telephone Company for use in the construction of 6½ miles of 12-duct subway between Union and Passaic, New Jersey, and 2¼ miles of 24-duct subway between Jersey City and Newark, New Jersey. The subways constructed were of multiple duct tile with a concrete foundation and concrete top protection. All manholes were built entirely of concrete. The outfit consists of a power batch concrete mixer mounted on a 7-ton motor truck which was also equipped with two

(*Continued on page 624*)



**A useful supply truck for fire-department use**

## Supply Truck for Fire Department

MENTION has been previously made in these columns of the tendency noted in practically all of our large cities to motorize the fire department and not only to use gasoline-engine propelled apparatus but also to replace steam pumping engines with gasoline motor-operated pumps. The horse-drawn supply wagon of the past with its baskets of coal for the steam pumping engine is now replaced by a special truck carrying the liquid fuel and lubricating oil so necessary to internal combustion engines. A vehicle of this type is shown in the accompanying illustration, this emergency oil and gasoline truck being a recent addition to the Chicago Fire Department. A pneumatic tire truck chassis is equipped with a special tank body having running board on which oil tanks are carried. The main tank has a capacity of over 500 gallons of gasoline, while the auxiliary tanks carry 65 gallons of oil. Suitable measures, funnels, tank-filling hose and other tools are carried in a special locker at the rear end of the truck. According to fire department statistics the average consumption of gasoline at a big fire is about 100 gallons, so it will be evident that an effective fuel-supply truck is an adjunct of decided utility. The truck can also be used in making the rounds of the various fire stations to make sure that the tanks of the apparatus are kept filled with lubricating oil and gasoline. The use of pneumatic tires enables the truck to make better speed when its services are required and lessens depreciation in routine work.

**The handy welding outfit that goes wherever a truck can go**

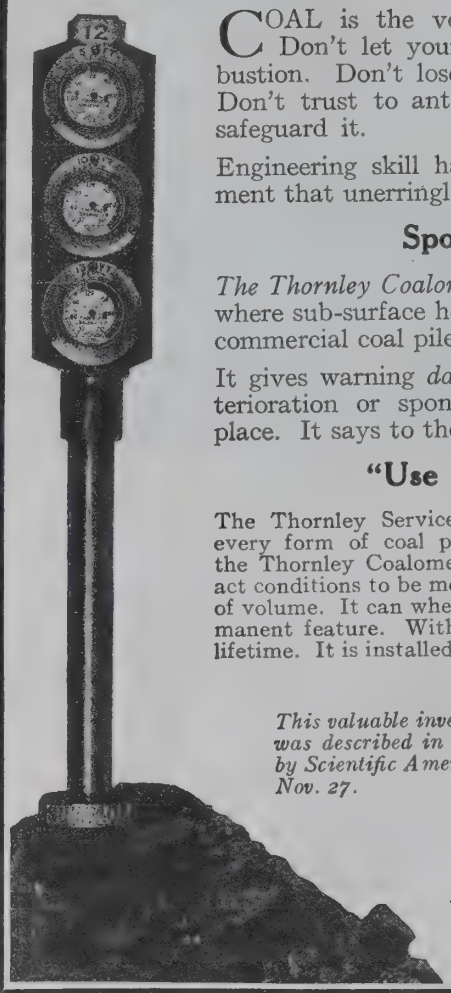
## Mobile Welding Outfit

THE system of welding in which an electric arc is used as a source of heat is of great value in making repairs on the boilers and other metal parts of ships. It is not always feasible to have a current supply of the proper value at the end of a wharf or in a dock where the repair work is carried on. In cases of this kind a mobile welding outfit is operated by a New York concern making a specialty of electric welding. The accompanying illustration shows the manner in which this special truck may be run along side of the boat on which the repairs are to be made. The body of the truck carries a special electrical generating set in which an internal combustion engine drives a dynamo giving current of the proper voltage and amperage to be used in welding. The power plant is self-contained and is independent of the truck engine, will operate on gasoline or kerosene and the arc welding machine will supply power enough for two operators. There is also an air compressor mounted on this truck driven by the truck motor which can supply compressed air for the pneumatic hammers and chisels used in preparing parts to be welded and in finishing off the completed weld. Among the remaining equipment can be mentioned two reels carrying 1,500 feet of welding leads, spare tanks for oil and fuel, air receivers and a complete work bench. The truck is electrically lighted and can be used for night work as well as during the day when rush jobs or emergency work must be performed.

***Left:*** **The wagon loader that simplifies filling the hopper.** ***Center:*** **The complete plant ready for the road.** ***Right:*** **The mixer discharging the contents in the trench**

**Three views of the automobile-mounted plant for mixing concrete**

# Protect Your Coal



COAL is the very foundation of production. Don't let yours go up in spontaneous combustion. Don't lose its B.T.U.'s by overheating. Don't trust to antiquated, inefficient methods to safeguard it.

Engineering skill has provided a scientific instrument that unerringly

**Spots Hot Spots**

*The Thornley Coalometer* indicates the precise spot where sub-surface heating is about to begin in any commercial coal pile, bunker, or cargo.

It gives warning *days* before actual danger of deterioration or spontaneous combustion can take place. It says to the watchful engineer

**"Use this coal next"**

The Thornley Service includes special engineering for every form of coal problem. Based on a unit system, the Thornley Coalometer is readily adjustable to the exact conditions to be met in any storage of coal regardless of volume. It can whenever desirable be built in as a permanent feature. With reasonable care it should last a lifetime. It is installed under a five years' guarantee.

*This valuable invention was described in detail by Scientific American, Nov. 27.*

**Thornley Coalometer**

"Spots Hot Spots"

*Address*

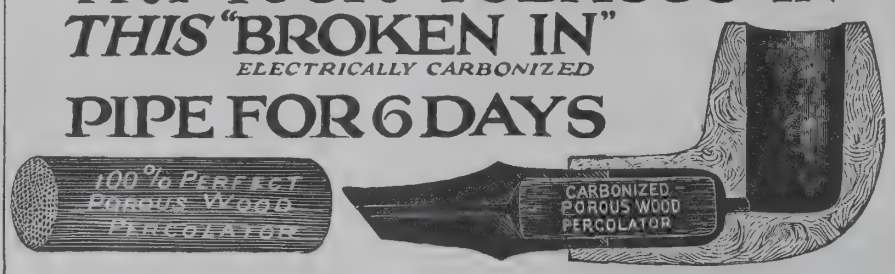
**F. C. Thornley & Co., Inc.**
**31 West 43rd Street, New York**



# TRY *YOUR* TOBACCO IN *THIS* "BROKEN IN"

*ELECTRICALLY CARBONIZED*

# PIPE FOR 6 DAYS




**LOAD UP A PERCOLATOR PIPE WITH A FAVORITE TOBACCO.** Light It—fire away and from the very first deep puff you will know that you are off on your **First Real Pipe Smoke.** We are so sure of the **PERCOLATOR PIPE**—So certain that it will give You a New Standard of Pipe Enjoyment—that we want you to give it this **Hardest Test of All Tests** at our risk.

**IN THE PERCOLATOR PIPE** there is no Possibility of "Back-Firing," "Tongue-Biting," "Juicy" Smokes, Because the **Sanitary, Carbonized Percolator** Filters **ALL** the Smoke Clean, Cool and Sweet. **THIS IS THE FIRST TIME That a Truly Scientific Principle of Filtration** has Ever been applied to Pipe Smoking. The Semi-Charred Porous Wood Percolator—**NATURE'S PRODUCT**—Positively Protects You from Nicotine and All Tobacco Oils and Actually Takes the **BITE Out** of Any Tobacco.

**EVERY PERCOLATOR PIPE IS SENT ON APPROVAL.** Smoke it for **Six Days,** If You Like It Send us $2.50. If You don't, Send the Pipe back and there will be No Argument. **YOU** Alone Are the Judge. Write us on your Letter Head, or Enclose Your Business Card. Or if you send money with order and the Pipe is Unsatisfactory Your Money Will be Returned Without Question. This is GUARANTEED. **ACT NOW. ALL PERCOLATOR PIPE BOWLS Are Electrically Carbonized,** and are Fully 90% "Broken In" and of course, are Positively Guaranteed Against Burning Through.

**Models Shown** Represent two very desirable "Happy Medium" size, shape and weight Pipes of Selected Genuine French or Italian Briar Root; Rich Friction Finish; Solid Vulcanite Stem; Sterling Silver Mounting; Length, 5 in.; Wt. 1¼ ozs.; High Class Workmanship. Price including 10 Carbonized Percolators, $2.50. Postpaid in the U. S. 25 cents Extra for Foreign Registry. Send for free Illustrated Pamphlet.

## THE PERCOLATOR PIPE CO.

**Suite A, 1931 Broadway NEW YORK, N. Y.**


# Recently Patented Inventions

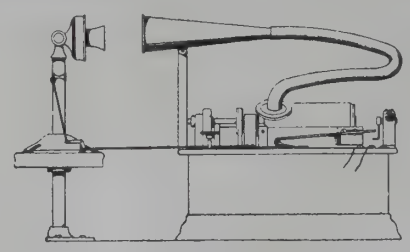
*Brief Descriptions of Recently Patented Mechanical and Electrical Devices, Tools, Farming Implements, Etc*

### Pertaining to Apparel

GARMENT.—L. T. GOLDBERGER, 395 4th Ave., New York, N. Y. The object of the invention is to provide a garment more especially designed as an outer garment to be worn by children and arranged to permit of readily converting the garment into a bloomer, or romper dress. Another object is to permit of conveniently opening the garment for sanitary purposes without requiring removal of any one of the component parts of the garment.

### Electrical Devices

AUTOMATIC BURGLAR ALARM.—F. A. TERRY, Marshfield, Ore. The invention relates to burglar alarms comprising a telephone set and a phonograph disposed near the set, with brake mechanism for holding a switch hook



A SIDE VIEW OF THE DEVICE

in normal position, a motor, an electric circuit for operating the motor, and completing the talking circuit. An object is to provide an alarm which will send in a call for help over a telephone whenever put into operation by the opening of a window or door.

### Of General Interest

PEN AND PENCIL HOLDER.—C. B. BIRD, 3617 Ellis Ave., Chicago, Ill. An object of the invention is to provide a simple device which may be secured to the clothing and which will hold pens and pencils securely. A further object is to provide a holder which will be held closely to the body of the person upon whose garment it is attached thereby preventing the pens or pencils from working loose from the holder.

LETTER BOX.—F. P. BOAS, 242 Cedar St., Tamaqua, Pa. Among the objects of the invention is to produce a letter box possessing a number of advantageous features; first the provision of a box having a rust-proof exterior, to provide a box having inner and outer relatively movable parts, the provision of means to limit the relative opening movement, to provide a permutation lock, to provide a form of cover to serve as a holder for newspapers or packages, and to provide a means for locking the box to a vertical support.

VANITY CASE.—S. HASLAM, c/o D. Evans & Co., Attleboro, Mass. The invention has for its object to provide a construction of receptacle having a pair of compartments therein, the partition dividing the compartments being secured in the receptacle and providing a hinged support for the receptacle cover, and also supports a catch which engages the cover to hold the latter in closed position.

### Heating and Lighting

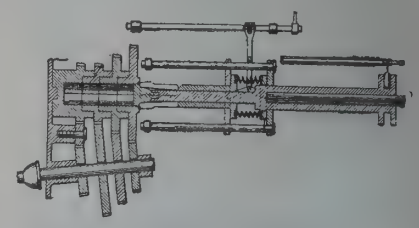
HEATER AND VENTILATOR. — J. A. GREEN, Long Beach Sanitorium, Long Beach, Cal. This invention has for its object to provide mechanism adapted for comfortably heating a room wherein fresh air is taken from the outside, heated and delivered to the room, while the foul air with the products of combustion, is delivered outside the room thus insuring in addition to the heating of the room, a thorough ventilation.

### Machines and Mechanical Devices

MECHANICAL MOVEMENT.—F. CLARK, 120 W. 57th St., New York, N. Y. The invention relates more particularly to a mechanism especially adapted for the conversion of reciprocating motion into oscillating motion. The primary object is to provide a device operated by one of the elevators of a typesetting machine to indicate certain conditions in the work being set up by the machine, the device may be readily attached to machines of this type as commonly constructed.

TIRE TREAD PULLER.—J. SCHMIDT, Box 885, Tracy, Cal. An important object of the invention is to provide a tire tread puller in which the pulley action is so exerted and in which the tire is automatically so positioned during the pulling action that the tread will be completely and cleanly removed from the tire carcass.

VARIABLE SPEED GEARING.—K. K. CLARK, 15 Riverside Ave., Jersey City, N. J. An object of the invention is to provide a gear transmission in which the driving and driven gears are always in mesh and to provide means



A LONGITUDINAL SECTION SHOWING THE SHAFT IN IDLE POSITION

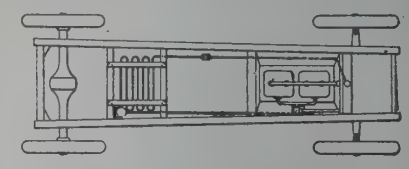
for connecting any of the driving gears with the driving shaft. A further object is to provide means for coupling the drive shaft with any one of the driving gears or position the drive shaft so that it turns idly when not transmitting motion to the gears.

MACHINE FOR COOKING AND DRAINING MATERIAL IN CANS.—A. S. DAVIES, 44 Garfield St., Santa Cruz, Cal. The invention has for its object to provide a machine for cooking and draining material in cans prior to covering and sealing, as for instance fish wherein the cans containing the material are moved continuously during the heating and draining, and are inverted to drain, and finally delivered in upright condition.

TROLLEY.—A. R. WESTERDAHL, Hospital Bay, Cuba. Among the objects of the invention is to provide a link or connecting rod which engages the sheave pins of the trolley and imparts great strength and durability to the structure; a further object is to provide a link which can be placed in position on trolleys as now constructed and which is capable of adjustment to suit the structure on which it is used.

### Pertaining to Vehicles

ANTI-FREEZING DEVICE FOR AUTOMOBILES.—F. WENDLING, 9317 87th St., Edmonton, Alberta, Canada. The invention relates to automobile and other motor cars using water-cooled motors and particularly to anti-freezing devices in connection with the radia-



A TOP PLAN VIEW OF CHASSIS SHOWING CONDENSATION TANK AND CONDENSER COIL AT REAR

tors of such motors, and has for its object the prevention of loss by volatilization of the volatile portions of anti-freezing solutions commonly used. The result is accomplished by an appartus capable of ready attachment to an automobile without interference with the normal operation thereof.

VEHICLE REAR END SIGNAL.—SHIBATARO HARA, deceased, Mrs. Lei Hara, Executrix, Muzquiz, Mexico. Among the principal objects of the invention is to provide a signal apparatus which may be employed in daytime as well as nighttime without adjustment or alteration; to audibly draw attention to the operating condition of the signal, and to provide operating mechanism for the signal, which is simple in construction and readily manipulated.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*Efficiencies of*
**JOHNS-MANVILLE ASBESTO-SPONGE FELTED INSULATION ON 5" PIPE**

| *Thickness in Inches* | *Temperature Difference Degrees Fahrenheit* 100° | 200° | 300° | 400° | 500° |
|---|---|---|---|---|---|
| 1" | 83.8% | 86.2% | 88% | 89.8% | 91.2% |
| 2" | 88.6 | 90.3 | 91.6 | 92.8 | 94.1 |
| 3" | 91.1 | 92.5 | 93.5 | 94.5 | 95.4 |

***What Insulation Efficiency Means***

90 per cent efficiency,—for instance,—means that the insulation of that efficiency saves 90 per cent of the heat that would be lost if the insulation were not applied.

***Example:***

One hundred feet of uncovered 5" pipe conveying steam at 150 pounds pressure through a room whose temperature is 70° F. *loses* 1,222,000,000 B. t. u. (units of heat) per year. An insulation 90 per cent efficient *saves* 90 per cent of this loss, or 1,099,800,000 B. t. u. (units of heat).

The equivalents of this *loss* and *saving* in pounds of coal are: LOSS—122,200 lbs., or 61.1 tons coal; SAVING by Insulation—109,980 lbs., or 55 tons coal.

The figures on pounds of coal lost due to uninsulated pipe and saved by use of insulation are based on continuous operation, 24 hours per day, 365 days per year and 10,000 B. t. u. available per pound of coal.

# Low pulse and high fever cost fuel users millions

***How much is lost heat from steam lines costing me?***

**Not long ago fuel users might ask in vain for the answer. Today everyone can know and save fuel through proper insulation correctly applied. Instruments for determining pressures and temperatures; charts and extended calculations are the tools that Johns-Manville Insulation Service is using to answer this very practical business question.**

**Whether you burn fuel in the house, the factory or the power plant, read what the science of insulation has accomplished.**

* * * * * *

Two symptoms always signal heat loss from a steam-pipe. One is lowered pressure in the pipe, the other is high temperature of the air surrounding the bare or poorly insulated pipe.

Now this falling of the pulse and external fever means that fuel in the form of heat is being lost.

It is Insulation's job to minimize this. And so well is this being done by the Johns-Manville Insulation Service that the materials applied are paying for themselves by the heat they save.

### This kind of Heat Conservation has become a science

In past years little was known of the real truths of heat loss. Materials were recommended after inadequate tests; in fact, today if many of the steam pipes covered sometime ago with materials of unknown value were checked up, their covering would be replaced by insulation of known value, and new records for economy set up.

Rising fuel prices make heat losses doubly serious and economy in heat transmission has been realized to be a real factor in cutting heating, power and manufacturing costs.

### Changing the physical design of Insulation

An insulation to be of maximum value must have more than the property of preventing heat loss. It must also have physical durability, for a short-life material means early replacement, so that if insulation values are equal, the most durable insulation is the most economical.

If it is desirable to reduce a loss, it is surely advisable to reduce the loss to a minimum. Believing this, Johns-Manville developed physically strong-felted insulations—and with obvious advantages to the fuel user. For these felted insulations are built up in ply form, physically strong and not easily damaged by vibration, handling or rehandling. These improved materials have not only overcome the physical shortcomings of most insulations, but made higher heat efficiencies possible. In fact, on test, one of these insulations has repeatedly been shown to be the most efficient commercial material in existence.

*To show the great flexibility of felted insulation, so vital to long life. Nothing to break, crack or powder off as in molded materials.*

### Insulation for every service

No one material should or will serve all practical needs. Steam service where high pressures are used demands different treatment than cold water or brine service. Johns-Manville, in realization of this, offer materials suitable for use indoors and out; overhead and underground and for every type of system, and not only does this service include the furnishing of the materials but their application as well.

The application of an insulation is vital to its performance in service, hence the necessity of controlling this factor if economical results are to be obtained.

### Johns-Manville Insulations

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**and its allied products**

INSULATION *that keeps the heat where it belongs*
CEMENTS *that make boiler walls leak-proof*
ROOFINGS *that cut down fire risks*
PACKINGS *that save power waste*
LININGS *that make brakes safe*
FIRE PREVENTION PRODUCTS

# JOHNS-MANVILLE
## Serves in Conservation

# Superheat Drills Holes

## *Few "steam metals" can withstand its active chiseling action*

So in great valves that control superheat flow for vital power production, leading designers call for essential working parts of Monel to withstand high speed gas erosion.

For, of all commercial metals, Monel alone has the ability to survive the combined chemical and mechanical attack of superheated steam at the high and rising pressures commonly used today.

In proof of this, Monel is used for guide stems, wedges, seat rings, spindles, dash pots, piston rings, clappers, piston lock nuts, pistons, etc., in the huge control valves built by Jenkins, Pratt & Cady, Crane and others equally prominent.

Monel is standard for service calling for acid, alkali, high heat and steam wear resistance. It has a prominent place in the specifications of such seasoned engineering organizations as J. G. White, Stone and Webster, Dwight P. Robinson Inc.

The name Monel identifies the natural nickel alloy—67% nickel, 28% copper and 5% other metals—produced by The International Nickel Company.

THE INTERNATIONAL NICKEL COMPANY
43 Exchange Place, New York
The International Nickel Company, of Canada, Ltd., Toronto, Ontario

THE larger picture is a "close up" of the clapper and seat ring shown in the broken out part of the small valve illustration. The clapper is seen about to lift in order to allow steam to pass into the line. The irregular spurts of steam show that the seat between clapper and ring is no longer perfect—that superheat has commenced to drill its way through. This drilling action is always in process where superheat is used, and the commonly used metals for valve parts eventually fail and allow superheat to cut through. For that reason Monel is the only safe metal for valve parts that are in constant contact with superheated steam—the only metal that insures always tight valve closure.

INCo Monel metal

THE INTERNATIONAL NICKEL COMPANY


### Radio Prize Winner for 1919

THE Lieut.-Col. Liebermann Memorial Prize, consisting of the interest for 1919 on $10,000 and awarded for the best work of the year in progressive discovery tending toward the advancement of radio, has been awarded to Roy A. Weagant, consulting engineer of the Radio Corporation of America, for his discovery—elimination of static interference.

This prize, founded a year ago by a friend of Lieut.-Col. Liebermann, who was killed in action leading his troops in France on August 8, 1918, was awarded for the first time to Leon F. Fuller, chief engineer of the Federal Telegraph Company a year ago.

Mr. Weagant, honored this year, is a native of Morrisburg, Ontario, Canada. He was educated at Stanstead College and McGill University. He studied physics under Sir Ernest Brotherford and first became interested in wireless through witnessing some of his experiments in Hertzian waves. He took up commercial wireless work in 1908 and in 1912 entered the employ of the Marconi Wireless Telegraph Company of America. He soon rose to the position of chief engineer and when the Radio Corporation of America absorbed the Marconi Company he was retained as consulting engineer.

Mr. Weagant is a fellow of the Institute of Radio Engineers and a former member of its board of directors and standardization committee.

### Power and the City

(*Continued from page 608*)

plants at San Pedro (the harbor district of Los Angeles) were of course founded to meet the stress of war, but their projectors were governed in their choice of a location chiefly by the cheap power supply.

Another great industry, made profitable by cheap power, is the canning of fish, particularly sardines, which abound in the adjacent ocean. Still another is the making of automobile tires. This was, of course, based on the successful growing in Arizona and southern California of the long-staple Egyptian cotton that is so essential to the making of good tires. The company that started Egyptian cotton growing in Arizona in 1918 speedily realized that the abundant water and cheap power of the aqueduct would not only enable it to make tires at Los Angeles for all Pacific coast points but would also enable it to ship them East by water and deliver them to its trade more cheaply than was possible to deliver from its big factory at Akron. Its cotton spinning factory, which alone will operate 33,000 spindles, for which the company expects to import 1,200 skilled women operatives from New England, was scheduled to open in June and the rest of the great tire factory, with 6,300 more operatives, in September. Another tire factory is to break ground immediately.

An industry more recently initiated in southern California is that of making vegetable oils. A company which has been operating a huge plant at Portland, Ore., recently broke ground at San Pedro for a new factory, to which it purposes to transfer its business. Cheap power was the controlling factor.

When the aqueduct was being built an $800,000 plant was built to supply the enormous quantities of cement needed in the work. Since the work was finished this plant has lain idle, its hugeness making it too costly to be successtully operated under competitive conditions. Recently it has been leased by the city to Portland people who are now transforming it into what they say will be the largest commercial potash factory in the world. While the ownership of great deposits of feldspathic rocks in the country southwest of Los Angeles was an inducement to the company to come there, yet it was only the cheap electric power that made it possible to operate at all.


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Each of these big industries has its own story—and a fascinating one at that. But the one factor that stands out in all of them is that they located where they did because of the cheapness and abundance of the electrical power of the aqueduct.

Other industries, impracticable without electric power, have been begun in a small way and will probably be rapidly expanded.

Among these is iron making. California, though not popularly known as an iron-producing State, nevertheless has an abundance of low-grade iron ores, which have never been mined because no coking coal for their melting was economically available. The electric furnace, however, does not need coke and is expected soon to turn out enough pig iron to supply the coast's needs for use in the fabrication of products for the local market.

A much more important class of ores, abundant in southern California but up to now capable of being handled economically only at Niagara Falls, is those from which chromium, tungsten, vanadium, molybdenum, manganese and other rare metals can be extracted. All such products, which though not great in tonnage nor volume are of enormous importance in the steel industry, can now be extracted by the electric power of the aqueduct and the prohibitive railroad freights to Niagara Falls eliminated. Again, the copper ores of Arizona and Utah, now shipped to Perth Amboy, N. J., for electrolytic refining, can be refined with a great saving in railroad freights by means of the cheap power of the aqueduct current. Truly, electrical water power is the present-day magician at whose behest factories and cities rise.

The extension of the light and power systems of the aqueduct throughout Los Angeles has not been carried on without strong opposition from at least one of the private electrical supply plants that supplied the city before the aqueduct was built. When the question of an aqueduct was first mooted, the companies in possession of the field naturally opposed the whole project. When overwhelmingly overruled by the people at a special election, they utilized the five years that it took to build the aqueduct in entrenching themselves in the city. Nevertheless, when, in January, 1917, the city began to distribute and sell electrical power its ability to conquer the field was so evident that one of the two companies immediately proposed serious negotiations for the sale to the city of all its transmission lines and business within the city limits. The company's stations were outside the city and much of its service was to extra city customers scattered over an extensive area, and this part of its business it of course wished to retain. Its proposal was so plainly in the public interest both in and outside the city that the municipality at once agreed to it in principle and stopped building distribution lines in the part of the city occupied by this company, pending agreement on details, thus avoiding the economic waste of building parallel lines.

The second lighting company, which occupied a large section of the city, took a different view of the situation and refused to consider negotiating the sale of its business to the city under any conditions. So the city "invaded" its territory by building distribution lines into it. Apparently, the contest was brief and decisive, 75 per cent of the company's customers changing over to the city lines as soon as these were available. Actually, however, the company's lines covered a large part of the urban portion of the city, and the part that had been invaded was comparatively small. It was of course apparent that the city could conquer the company's territory if it cared to continue the invasion on a large scale, but this would involve a heavy economic

## The Hack Saw Chart

Which saw will insure the most economical cutting of any particular material? One has only to consider the multiplicity of factors as represented by the material, the saw and its operation, to realize the difficulties encountered in arriving at the correct solution of this problem.

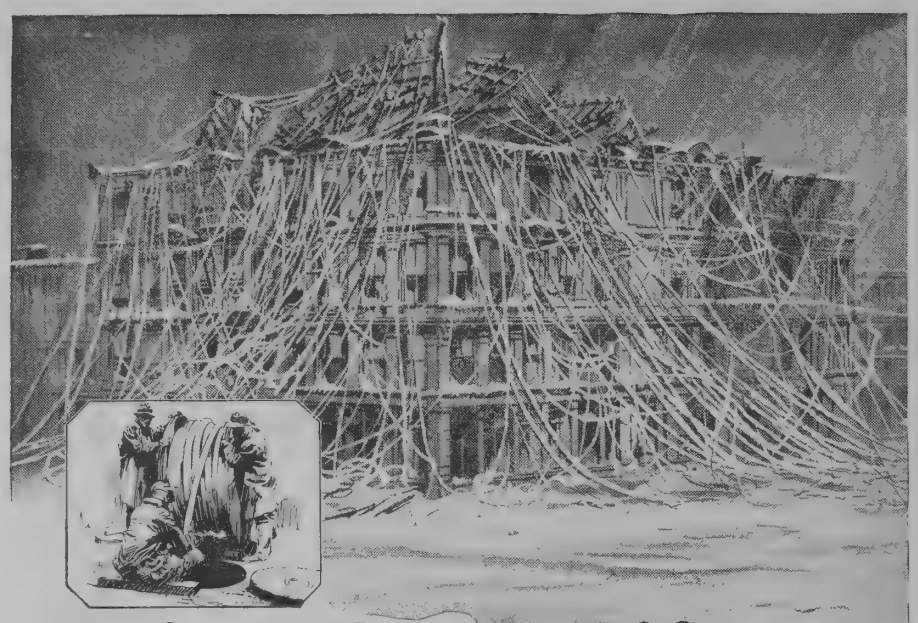
## Necessity Universally Recognized

Practically every saw manufacturer has made some attempt to answer the question. A number have gone no further than to suggest the obvious—that is, that the saw used for cutting brass or sheet metal should have more teeth per inch than that used when cutting steel or round stock. Some, however, go further than this though not necessarily to the extent of conducting careful tests and the compilation of records over a series of years as one or two have done, but yet far enough to recommend with some degree of definiteness, the employment of blades of certain physical characteristics, to cut certain classes and shapes of metal.

## The Practical Solution

One manufacturer—The L. S. Starrett Company—as the result of experiments and tests, has divided materials and shapes into nine such classes, the distinction being based on observation of the influences exerted by the hardness, ductility, crystalline structure and chemical composition of the various metals, and the diameter and shape of the material to be cut. For these different classes of materials, different blades have been designed and manufactured, and the classifications, with the blade recommended for each, have been embodied in the HACK SAW CHART.

In a more elaborate and technical way this Chart might have been made up so as to show the composition and temper of each blade, but for the fact that saw numbers on the chart supply all necessary information where saws of this make are employed.—From *Hack Saws and Their Use*, published by The L. S. Starrett Co., Athol, Mass., for free distribution. A copy of the Starrett chart will be sent free upon request.



# The Contributions of Science

The greatest material benefits the world has received have come from the laboratories of the scientists. They create the means for accomplishing the seemingly impossible.

Science, after years of labor, produced the telephone. From a feeble instrument capable of carrying speech but a few feet, science continued its work until now the telephone-voice may be heard across the continent.

In February of 1881 a blizzard swept the city of Boston, tearing from the roof of the Bell telephone building a vast net-work of 2,400 wires. It was the worst wire disaster the Company had sustained.

Now through the advance of science that number of wires would be carried in a single underground cable no larger than a man's wrist.

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*There's a Tycos or Taylor Thermometer for Every Purpose*

loss by the necessity of duplicating the company's lines and would at the best unnecessarily use up money which might better be used in supplying parts of the city that had no electrical service at all.

So the city simply held the part of the area that it had conquered, and for the time being spent its available money elsewhere, notably in building heavy transmission lines to the harbor district, where the municipal docks, cotton compresses, fish canneries, shipbuilding, and other plants wanted the power to supply their growing needs. It also built into an industrial district on the east side where many factories, large and small, were using oil for fuel; this was done at the request of the United States Government, which desired to conserve oil for war and other purposes by substituting hydro-electric power. This resulted in a marked rehabilitation of the district.

The electrical energy at first in actual use was derived from what is known as the San Francisquito power plant No. 1, located on the line of the aqueduct 47 miles northeast of the city, which develops 37,500 horse-power, and from a minor plant which develops 3,000 horse-power and is commonly used to help carry the peak load at the rush hours of the day. Another plant, known as San Francisquito No. 2, located in the same canyon seven miles nearer town, was finished in June and has added two units of 19,000 horse-power each to the existing service. A third unit of 19,000 horse-power unit will be added at this plant later. Two other plants, San Fernando and Franklin Canyon, located much nearer the city, will contribute 14,000 horse-power by Christmas. The same water will successively furnish the power to each and every one of these plants.

All told more than half the total developed and potential power of the aqueduct is practically at the city gates; the rest is more distant and will require longer though by no means unusually long transmission lines.

## Solving the Labor Problem—III

*(Continued from page 611)*

the fact that the management and the men, always having played fair, have come to have confidence in each other.

### Relationship of Wages to the Cost of Living

In formulating our system of industrial relations, naturally the question of wages occupied a leading position. We devoted a great deal of time and study to this subject, going back into history for suggestions and guidance. We found that a comparative study of the trend of the cost of living for many centuries and in many countries, showing the natural effect upon it of various wars, furnished us with a basis for computing the probable trend in America during the period of the late war and subsequent production.

We then drew up plans for a steadily increasing wage scale, designed by automatic periodical advances to keep pace with the increasing cost of living and thereby make it possible for the workmen to maintain a normal standard of living. We are glad to be able to state that up to the present time, this forecast has been fully justified, the average wage having more than doubled, while the purchasing power of the dollar has shrunk by one-half.

In connection with our study of this subject, we found no *satisfactory* system of bonuses, profit sharing, premiums, piece rates or other participation in earnings of any kind, although some of these plans have been adopted and are apparently successful in many other industries.

Our policy is to maintain what we consider to be a just rate of interest on capital stock and then, after making provision for the necessary overhead charges, we share our profits with our employees every two weeks in their pay envelopes.

### How So-called "Welfare Work" Is Handled

In working out a system of so-called "welfare-work" we have realized that to be effective it must not carry with it to the minds of the men any idea of charity or paternalism. This conviction we found to be very strong among the men themselves. They wished that everything that was done in the way of benefit societies, recreational clubs and restaurants should be regarded as services to the employees for which they pay. They believe that the cost of these things is a part of the cost of production. Consequently, the maintenance of these departments stands on the same basis as the maintenance of purchasing, cost, or payroll departments, and the men understand that through their production they are paying for such service. The costs are charted, to show cost of each department on a "per day, per man" basis. These charts are placed before the men with the understanding that, by a two-thirds vote in the factory, any of the service activities, other than those necessary to comply with State requirements, can be discontinued.

There is not space within the limits of this article to describe these welfare activities in detail. There is the factory kitchen and restaurant, which supplies food at a figure slightly below cost; a library to which employees have easy access at all times. The latter is operated as a branch of the main public library, making it possible for a man to order any book from that institution on the card issued by the company's branch. Recreation in the form of athletics forms a large part of these activities and includes a baseball team, basket ball, bowling, football and other clubs.

A very important organization, also managed entirely by the employees, is the Benefit Society, under which, in case of sickness, a member is paid $12 a week for twenty weeks and $10 a week for the next twenty weeks. The death benefit is $500, half of which is donated by the company and the other half paid by the society. Another activity that is exceedingly popular and has proved to be very helpful is the factory publication known as the *White Book*, which is published monthly. It is mailed free of charge and reaches some 20,000 people. Contributions are received from all departments, both in the factory and office, and it serves as a medium of mutual interest and education for management and employees alike. The more serious part is occupied by articles of a technical or educational nature and by editorials which place before the employees all of the company's policies, with full discussions thereof.

### Americanization of Employees

For the benefit of non-citizens employed in the factory—about 20 per cent on January 1, 1919—a course of instruction is given during company time by an educator particularly fitted for this work, the principal object being to enable these employees to get their second papers. On January 1, 1920, after a year of such instruction and assistance, there were but 68 out of 5,826 employees who had not as yet secured their first papers.

### Conclusion

We desire that our people be reasonably contented. We want them to realize that the position of our establishment in industry, and its continued growth offer them their opportunity for development, and practically secures for them their economic status in society. We want them to understand that it is only by the continuous growth of the industry that we are all raised out of our present conditions, and then only through work directed by intelligent management. We give them to understand that we can attain our ideals only by all of us diligently working together for one common end. We are educating our men in the fundamentals of economics, in the bene-

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### Our Diamond Industry

(*Continued from page 614*)

getting "on the list" is a long and tedious one, sometimes requiring fifteen or twenty years of persistent effort on the part of an individual.

And so not only were the diamonds and the workmen imported from Europe, but the buyers of the rough stones had to be imported, too. It is because of this fact that many of the important New York diamond merchants even today are descendants of Dutch families, and can trace a lineage of diamond merchants through a century or more.

It is said that fully 80 per cent of the diamond cutters in New York are Hollanders or the sons of Hollanders, and practically all of them are from families in which every male member is a diamond cutter. These cutters are all members of an international union which controls very closely the apprenticeships to the trade. Until very recently it was practically impossible to learn the trade unless the lucky applicant had some relative already in the union. The union fixes wages, but the wage any individual receives depends upon his skill and speed as a workman. A year ago, when the demand here for diamonds was phenomenal, diamond cutters in New York made from $100 to $150 a week.

Excepting that steam and then electricity have been applied to the diamond cutters' tools to replace foot-power, there has been slight progress in the art since the days of antiquity. The only really important invention to aid the diamond cutter during many centuries of steady activity has been the diamond saw, which has been in use for a number of years. When the rough diamond arrives at the factory each stone is closely examined to determine the weight, flaws, and the direction of the planes of cleavage, which can only be dete mined by an expert. If it is decided that the stone should be divided into two or more pieces, the cleaver cements the diamond to a wooden stick and with another diamond cuts a narrow groove at the exact spot selected. A dull steel knife is inserted in this groove and a smart blow struck upon it. If this has been skilfully done the diamond divides at once and both surfaces are as smooth as if they had been polished. The process requires the greatest skill and care on the part of the cleaver for any error would cause serious loss.

The later method of sawing accomplishes the same result but with less chance of error. Half of the stone is imbedded in a small metal receptacle filled with melted soft metal and the edge of the circular bronze saw is set against it at the point selected. The saw gradually cuts its way through. It may require from three to four days to cut through a large diamond.

After the stone has been cleaved and sawed into the most economical sizes for cutting, the pieces are fastened with a strong adhesive to the demountable spindle of a small lathe. A number of diamonds are similarly mounted. A diamond is screwed on the end of a handle and is used as a tool for cutting the diamond in the lathe, being held against it by the workman. The stone used as a

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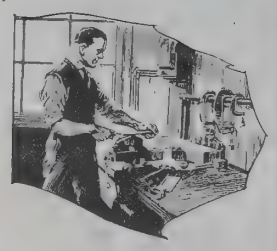

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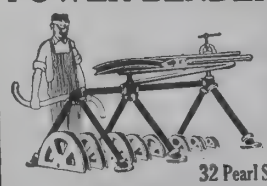

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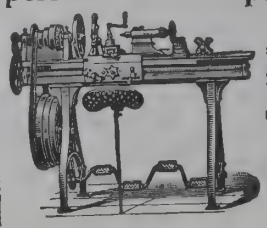

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tool is worn away at the same time, and it is manipulated so that both stones are gradually brought to the proper shape. When the stone in the lathe has been finished, the one used as a tool takes its place and another is used as a tool. Thus the diamond is "turned" into a lusterless cone of the usual diamond shape. Then it goes to the polisher.

The polishing takes place on a horizontal disk which revolves at an extremely high rate of speed. The disk is of a close-grained semi-steel which founders in the country have so far been unable to produce. The working surface is impregnated with a mixture of oil and diamond dust and when the stone is held against the revolving disk a flat face or "facet" is gradually ground on it. To secure the greatest brilliancy the stone must be cut according to an exact formula, having a definite number of facets and with precise angles between them. The stone is mounted either in a mechanical holder or at the point of a pyramid of lead and tin composition, while the holder is secured to a short copper rod. By bending this copper rod one way or the other the workman varies the angle of the cut. He is provided with a crude gage for determining the proper angle of the facets; but for the final accuracy he must depend mainly on his eye. Since the brilliancy and value of the stone depend on the accuracy of his eye, it can easily be seen why the polishing of these precious gems is entrusted only to the most expert workmen.

However all that may be, Yankee ingenuity has invaded even the sanctified realm of the diamond polisher. A machine has been invented for regulating automatically the angle of the cut, size of the facet, and number of facets. Still, a majority of gem experts continue to believe the process is not entirely successful, and it seems likely the expert diamond cutter is in no immediate danger of extinction. Each stone, it is argued, ought to be considered as an individual, for there are no two alike. Each should receive a little different treatment to bring out its full value and this can only be done by the expert workman. For this reason the best stones, no doubt, will always be cut by hand.

Recent news dispatches from Berlin bring the statement that at last German scientists have succeeded in making synthetic diamonds which cannot be detected from genuine stones by any of the accepted tests. New York diamond merchants generally disbelieve the statement.

"I do not believe," said a gem expert to the writer, "that it ever will be possible to duplicate a diamond so that an expert cannot detect it. The successful manufacture of synthetic rubies and sapphires has not affected the market for these genuine stones. The genuine stones are selling for a higher price today than ever before, and that in spite of the fact that the synthetic stone is being made better and cheaper every day. Even if synthetic diamonds are achieved—and I doubt if they ever are—I do not believe the market for real diamonds will be in the least affected."

Along with the growth of a diamond industry in this country, and partly because of it, the average American has become "diamond wise." He knows a good stone from a bad one; he can detect a flaw; and he knows a good color.

"Fifty years ago," says the gem expert, "it was only necessary for a jeweler to guarantee that a stone was a genuine diamond to satisfy the customer. Today the customer knows too much about diamonds to be satisfied with any such superficial guarantee. This creates a demand for fine gems which, in turn, is the reason for the existence of an American diamond industry.

"Fifty years ago it was only the leading jeweler of any city who carried diamonds in stock. Today you can see windows full of them on display, even at the cheaper class of stores. The diamond has come to be something of a factor in American life, and I think it has come to stay."

## Special Truck Body for Plate Glass Transportation

(*Continued from page 617*)

height of a man's hand when the arm is extended for effective lifting. Consequently, loading and unloading the truck is much easier than would be the case if the glass sheets were carried higher. The closer to the ground the glass comes, within reasonable limits, the less the chances of trouble due to dropping it. One of the important advantages incorporated in the construction of the body is the fact that the sheets of plate glass are loaded into it in a vertical position instead of being placed horizontally. The advantage of this is that sheets of plate glass of large size can be carried on a body of ordinary width that could not be handled very well if a wide truck body was required, on account of difficulties of maneuvering in traffic. The rack sides of the truck body are provided with special clamping members that hold the plate glass firmly against the packing strips. These clamping members consist of slotted guides having felt pads at the end, which are held in place against the glass by means of substantial wing nuts. The method of using the clamps is clearly shown in the rear view of the truck. The wheel base of the truck is 14 feet and the frame length 16 feet. In order to supplement the easy riding the truck is fitted with special cushion wheels which supply a resiliency greater than that which would be obtained by the ordinary solid tire. It is stated that since the truck has been in service, no matter what size sheet of glass has been carried, not a single piece has been broken in transit.

## Mobile Concrete Mixing Plant

(*Continued from page 617*)

gravity hoppers, one for sand and the other for stone, together with a water tank.

The materials for concrete were assembled at some convenient central location on the job and the stone and sand loaded into the hoppers by a power loader, as shown in one of the photgraphs. Bags of cement were also put on board and at full load the outfit carried material sufficient for five cubic yards of concrete. The power mixer was fed by a laborer on the truck shoveling sand and stone from openings at the bottom of the gravity hoppers and the concrete was poured directly into the trench or manhole excavations by means of a spout. It was found that with a little practice the truck chauffeur could regulate the forward movement of the truck to give the required thickness of concrete in the trench, so that very little hand spreading was necessary. This equipment was developed to meet the conditions existing along the route over which the subway was constructed between Union and Passaic, N. J., where traffic was very heavy, the highway comparatively narrow and bounded on each side by swamps.

To deliver the concrete material along the trench and mix it with a non-automobile mixer would have required platforms in the swamps for the mixer and material about 500 feet apart at a very high cost. The saving by the use of the automobile concrete mixing plant was, therefore, very great. On the Jersey City-Newark run, while it would have been possible to mix concrete in the usual manner at various stations along the trench, the use of the automobile mixer plant was found to be about 25 per cent cheaper than the use of fixed concrete mixing stations and the dumping of concrete into the trench and manhole excavations from wheelbarrows.

*IN THIS ISSUE:*

OUR LAGGING GOLD PRODUCTION
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# *In the Land of Perpetual Light*

TWILIGHT! That impressive time when the sun goes down behind the hills and calls it "a day." In the city, street lamps blaze forth to show the way, trolley cars become moving houses of light, while one by one the windows of office buildings, stores and homes take on a more cheerful look. In the country, a lone farm house on the hill stands out as a beacon of comfort, and down in the valley a locomotive headlight guides the traveler safely on his journey. The night has come, but light remains, for electricity knows no darkness.

Electric light is no longer a luxury. From Edison's first lamp to the present-day MAZDA, forty years of development have made this element of civilization more and more a necessity. It has made the streets of large cities and small hamlets safer and more attractive. It has blazed the path of the iron horse on land, and has cut a course through fog and mist for giant ships on the high seas. It has saved lives of men who work in the bowels of the earth. It has made motor highways of country trails. It has enabled surgery and medicine to make more rapid strides in correct diagnosis. On the farm, it has brought city comforts, and in the office and factory it has made for better work and happier workers. In short, it has made the world a safer place, a more cheerful place in which to live.

Perhaps the greatest contribution of the General Electric Company to better light has been the development of the MAZDA lamp—but G-E service also includes the research and the initiative necessary to put *the proper light in the proper place*, whether for a tiny flashlight or a huge marine searchlight. G-E engineers have not only developed lamps, they have fostered scientific illumination, and they have created and built the apparatus which has made modern lighting possible, from the harnessing of Nature to generate current, to the safe transmission of this current to the places where perpetual light is desired.

95-172

GENERAL ELECTRIC COMPANY

SEVENTY-SIXTH YEAR

# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

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NEW YORK. DECEMBER 25. 1920

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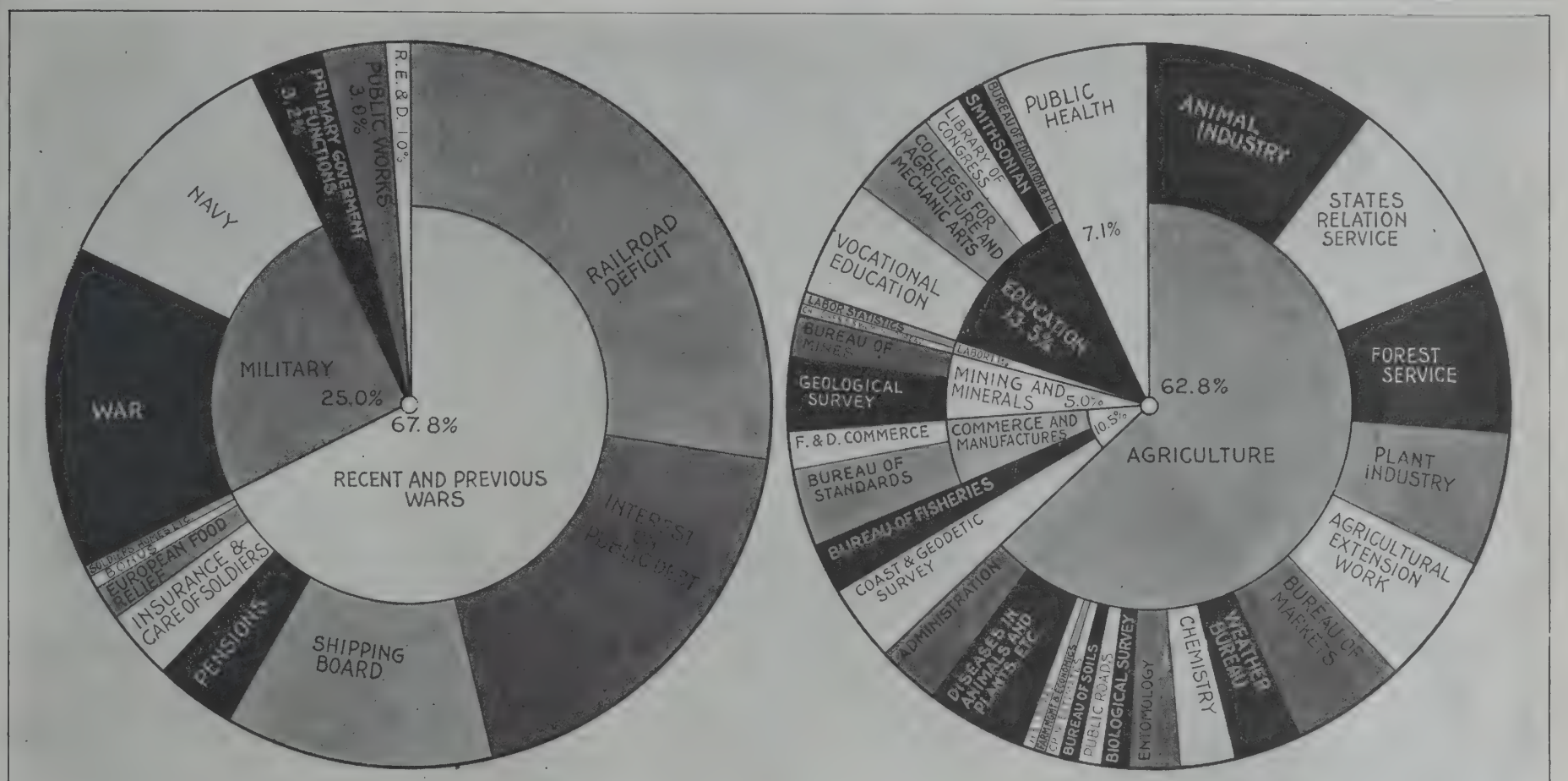


*Left:* Distribution of the entire Governmental expeditures for the fiscal year 1920. Over 92 per cent goes for war and things connected with war: a bare one per cent for research, education and development—which gets so small a share, in fact, that there is not room to label it in full. *Right:* The $57,000,000 constituting the one per cent of our national budget allotted to this worthy cause of promoting the public knowledge is distributed among the various fields as here indicated.

**A graphic demonstration of how the Federal Government spends its money in the course of a year**

## Where Uncle Sam's Income Goes

By G. H. Dacy

OUR national budget for the recent fiscal year which ended July 1, aggregated $5,686,005,706. Of this vast appropriation only about one per cent, or $57,093,661 was devoted to research, educational and developmental activities. This money was used by the national Department of Agriculture, Geological Survey, Bureau of Mine, Coast and Geodetic Survey, Bureau of Standards, Bureau of Fisheries, Bureau of Foreign and Domestic Commerce, Bureau of Labor Statistics, Women and Children's Bureau, Vocational Education, State Colleges of Agriculture and Mechanical Arts, Library of Congress, Smithsonian Institution and the Public Health Service.

On the basis of a population of 110,000,000 people this total budget means the expenditure of $50 per capita as compared with an expenditure of only fifty cents a year per capita for research, investigational and educational activities. Of the total government appropriation for this year, 67.8 per cent was devoted to paying off a portion of the indebtedness which has obtained from recent and previous wars. This included interest on the public debt, railroad deficit, the maintenance of the Shipping Board, European food relief, soldiers' homes, bonuses, insurance and care of soldiers and pensions. It took 25 per cent of the gross funds to maintain the military enterprises of Uncle Sam; 3.2 per cent of the appropriation was devoted to the maintenance and operation of primary government functions such as Congress, the Executive, the Federal courts and similar national projects while another 3 per cent was used in supporting public works, including rivers and harbors, public buildings, reclamation service, post roads, national parks and the railway in Alaska.

The outstanding feature about the annual congressional appropriations is that only one per cent is devoted to promote scientific research, to increase production and to intensify efficiency, to develop wealth, to promote public health and to conserve our national resources. To the layman who carefully studies these figures it appears that Congress practices parsimony and economy backside forward when it minimizes the scientific and developmental funds. It is largely through these agencies that the wealth and financial resources of the country at large are increased. To impede their maximum development and operation is to curtail the potential productivity of many of the industries and allied activities.

The appropriation budget for the next fiscal year is drastically curtailed as concerns the funds made available for research and investigational enterprises. Instead of cutting the appropriations for the government enterprises which ordinarily exhaust at least 99 per cent of the total funds, Congress carved away at the moneys destined for scientific research to the extent that it will be necessary to abandon much important investigational work. For example, the national Department of Agriculture will have to give up more than 65 lines of experimentation which previously it has been engaged in. Much of this work is of a character which demands consecutive continuation year after year for permanently worth-while results.

About 62 per cent of the government funds appropriated for research and investigational operations are devoted to the work of the national Department of Agriculture. Agriculture is the most important industry of the nation and farming and animal products raised in the United States are worth at least $25,000,000,000 a year. It is of fundamental importance to city residents that agricultural production be maintained and increased with the relative growth of population. The Agricultural Department works with such ends in view: to increase production, to keep food prices within the reach of the masses, to promote the interest of the farmer in his work and to improve rural living conditions and make life in the country more pleasant and attractive. It is spending about $1.50 for every $1,000 of value of agricultural and animal products and, without question, the results achieved pay many times the cost of the work.

The investigational activities of the other government departments engaged in scientific research are almost as valuable to the country at large although not so extensive as those of the Federal farming scientists. Excluding food products, tobacco and liquors, the annual value of manufactured products in this country, over and above the value of the raw materials entering into them is approximately $12,000,000,000. Last year the funds available for the investigations of the Bureau of Standards only admitted of the national scientists spending $.15 per $1,000 of manufactured products in all its work and only one-half of this sum was devoted to work which promoted the development of such manufacturing enterprises.

The other national agencies referred to above have operated under similar handicap, due to similar financial shortages. Unless scientific research is to decline appreciably in this country, our future Congresses must be imbued with some far more rational sentiments than heretofore, so that they will loosen the Federal purse strings and apportion more money for experimental and investigational activities of this description.

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*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## The Progress of the Einstein Judges

THE Einstein contest has now reached the stage where the participants are writing and telephoning to ask us when we are ever going to announce the winner. This, we suppose, was to be expected; certainly a bit of impatience may be pardoned in one who awaits an announcement involving himself and five thousand dollars. But we shall have to ask the contestants to display the same charity toward us that we are prepared to display toward them.

By a curious trick of fate, there were submitted in competition for the prize exactly 300 essays. Of course a few of these did not require serious consideration—this is inevitable in a contest of such magnitude. But after excluding all the essays that were admittedly not about the Einstein theories at all, and all those whose English was so execrable as to make them quite out of the question, and all those which took the subject so lightly as not to write reasonably close to the limit of 3,000 words, and all those which were [illegible] to explanation of the manner in which Einstein theories verify those of the writer, and all those in which the writer attempts to substitute his own cosmic scheme for Einstein's—after all this, there remained some 275 essays which were serious efforts to explain in simple terms the nature and content and consequences of Special and General Relativity.

Now there may be those who consider that two learned exponents of Einstein's doctrines ought to be able to rush through these 275 esays, allowing some ten minutes to each, and stating definitely at the conclusion of the process that No. 144 is unqualifiedly the best. Unfortunately, in practice it is not possible to do anything of the sort. It is necessary to read all the essays carefully, and not merely once but several times, gradually eliminating those which are not the best. As the number of survivors decreases it is necessary to bring to each essay a closer and ever closer scrutiny. Extreme care has to be taken in deciding whether the various essays preserve the proper balance between scientific accuracy and intelligibility of treatment. The final decision must perforce be a very delicate one: of several surviving essays that discuss the subject adequately and involve no material scientific infelicity, which embodies the best selection of material presented in the way best calculated to be understood by the intelligent general reader?

It is not the least of the difficulties involved that all this work has to be undertaken by the Einstein editor and the judges without disturbing any more than necessary the editorial routine, and without prejudicing at all the ordinary academic duties. It is therefore utterly out of the question to hang up any speed records in determining the winning essay. Early in the month, when we last communicated with the judges, the 275 had been reduced to 17, with a strong probability that of these, some half dozen would immediately fall by the wayside. But the long, hard pull will come in the effort to decide which of the last six or eight or ten is really the best combination of skilful planning and successful execution. We believe that the judges, with or without the final arbitration of the Einstein editor, will reach a decision in time for the winning essay to appear in one of our January issues. But it is entirely conceivable that the processes of final elimination may strike a snag that will make this out of the question. In any event, the contestants may be assured that their suspense will be ended, and the public at large that the prize essay will be presented in our pages, at the very earliest date possible.

Later we shall have something to say in detail about the character of the essays received, the scope of the contest, and other points of interest. For the present we may remark, as we have done explicitly on a previous occasion and implicitly just above, that the caliber of the essays submitted was on the whole high. There were many which would have been well worthy of the prize in the absence of others that were distinctly better—many which it was not possible to eliminate on the ground of specific faults, and which could only be adjudged "not the best" by detailed comparison with specific other essays. While nearly one-half of the essays followed substantially the same general outline, the other half showed almost as many ways of attacking the subject as if comprised of separate essays; so the aim of securing a wide diversity of treatment was fully realized. There is no slightest doubt that the contest has been a success; after the award of the prize our only embarrassment will be one of riches.

## Are We to Become the War Pace-Maker?

A FEW years ago, in the course of a political speech-making tour, the President made a complete right-about face from his previous attitude of deprecating any military preparation, by stating that the United States ought to have "incomparably the strongest navy in the world." The phrase was at once caught up by the Hearst papers and became the watch-word of certain politicians among us, who apparently would like to see the United States take the place of Germany as the armament pace-maker of the world.

The SCIENTIFIC AMERICAN always has, and always will, set its face firmly against such a movement; for we consider it to be not only opposed to the spirit and purpose of the United States, but absolutely unwarranted by the present naval and political condition throughout the world.

Before the World War, all Americans, the General Board of the Navy included, who believed in a vigorous naval policy considered that the naval defense of the country would be complete if the United States possessed the second strongest navy in the world. Thanks to our great building activity during the war, and to the fact that Germany, formerly the second power in strength, has been eliminated, the United States is not only the second naval power at the present time, but is so firmly established in that position that in dreadnaught and battleship strength, it is fully equal to the navies of Japan, France and Italy combined. Not only has the goal been reached, but we are established in the coveted position with a preponderance of strength never dreamed of at the time when the President and his naval secretary were strenuously opposed to making the increase in our armaments which would give us second place in naval rank.

The war has left behind it a legacy of heavy taxation and the people of this country are looking to Congress to set in force a too-long-delayed policy of drastic economy. Of the total Government budget, some seven-tenths or more is devoted to wars past and future and the small remnant to civil purposes. There is a very proper demand that the pruning knife shall be put in where it will produce the quickest results. It was the universal hope that expenditures, particularly in the Navy, would be brought down to a reasonable limit. Hence, the announcement that the Secretary is asking Congress for between 600 and 700 million dollars appropriation for the Navy this year has been received with something like consternation. The naval budget before the war ran somewhere in the neighborhood of 150 million dollars. Allowing for the higher cost of materials and for a larger personnel, et cetera, a budget of four hundred million dollars should have been sufficient. The call for nearly 700 million dollars would seem to indicate that the Navy Department has taken no note of the altered world conditions, or of the plea for a general easing of the burden of taxation.

It would be easily possible to reduce the appropriation without any prejudice to our naval interests. Thus, we have under construction eighteen capital ships at a time when all other nations except Japan have ceased such construction; moreover the work being done by Japan is limited as to amount. Construction of the six 43,000-ton battleships, costing $40,000,000 each, could very well be allowed to rest until the financial condition of the country and the exigencies of the naval situation render work upon them possible and advisable. This subject, however, we shall return to in more detail in a future issue.

We note in a dispatch to the press from Washington that there was brought to the attention of Secretary Daniels the suggestion of Senator Borah for an agreement between the United States, Great Britain and Japan to curtail naval construction for a period of five years. Commenting upon this, the Secretary is reported to have made the extraordinary statement that an alliance of this kind would be interpreted as an attempt by these three nations to dominate the world. We remember the day when the Secretary assured us that if the United States increased its armaments, it would have the same effect. In his mind at least, our beloved country is a disturbing influence in the world, whether we build ships and guns, or whether we agree not to build them. Mr. Daniels tells us that the world is still "shell-shocked." If so, he has certainly got his share of the trouble; for if we credit him with being sufficiently humanitarian to wish to get the world out of its shell-shocked condition, we find that apparently his method would be to put our Navy in the position to get the world more shell-shocked, by doubling our present strength in ships of war.

Furthermore the General Board of the Navy recommends that in these piping times of peace, when practically the whole of the world has quit warship building, we not only complete the eighteen capital ships and other ships that we are building, but that Congress authorize four more capital ships, 30 10,000-ton cruisers, 8 gunboats, 18 destroyer leaders, 12 long-radius mine-laying submarines, 6 cruising submarines, 4 airplane carriers, 3 destroyers and 3 submarine tenders, or some 90 ships in all.

And so the merry game goes on; while the Secretary of the Treasury plays his accompaniment, by suggesting that the income tax for the majority of us good people be raised from four to six per cent.

## The Promise of the Commercial Airship

WHEN "R-34" was in this country, in the summer of 1919, the officers in charge of the ship were unanimous in the belief that the commercial future of the airship was assured. This conviction was based upon the performance of "R-34" in crossing the Atlantic, and the certainty of an increase in the size of the airship, with all the well-known advantages which come with size, and secondly, upon certain experimental work which was then commencing, designed greatly to increase the carrying capacity and range of the airship by a more economical use of fuel.

Since that day, the Research Department of the Air Ministry has taken the matter in hand, and we understand that the preliminary investigations are full of promise. Stated in a general way, the economies which are aimed at are to be secured in two directions. The hydrogen which ordinarily is discharged is recovered and used in an engine designed for this purpose, and it is estimated that the value of the gasoline which will thus be saved will be sufficient to recover the cost of the hydrogen which is thus turned to useful account.

The reduction in the gross weight of an airship due to the consumption of gasoline, necessitates the discharge of hydrogen to compensate for the reduced weight. This hydrogen represents a dead loss. Experimental work is now being done in developing apparatus for condensing the water of combustion which passes out through the engine exhaust. It was this development to which the officers of "R-34" made particular reference in 1919, and the Research Department of the Air Ministry has found that it is possible to recover in this way a weight of water almost equal to the weight of fuel consumed; thus again reducing the amount of hydrogen which has to be discharged. Not only will there be a saving of hydrogen by these two methods, but in any given airship, it will be possible to carry a greater weight of passengers, mail, freight, et cetera.

## Aeronautics

**Sweden's Subsidy Plan.**—From a message from Stockholm it appears that the Swedish Government is determined to encourage the development of an aerial postal service. It has decided to subsidize the Swedish Air Traffic Company by the payment of 500 kroner for each journey between Malmoe, Copenhagen, and Warnemunde. This scheme of subsidizing aerial travel companies has already been put into effect in other countries, with satisfactory results.

**The Helicopter Problem.**—Slowly but surely it appears that the helicopter problem is being solved. For one thing it is no longer being handled in a haphazard, hit-or-miss, guess-work manner. It is now receiving the attention of engineers and scientists who do not go into anything without acquainting themselves first of all with the mathematics and mechanics and the whys and wherefores. From *Aeronautics* we learn that M. Damblanc of France has recently carried out some experiments with a full-sized direct-lift machine under the auspices of the French Government. He is believed to be the leading authority on this subject at the moment. The development of a practical machine of this nature is of great importance, particularly to commercial aviators.

**America's Speed Record.**—The winner of the Pulitzer Trophy race held last Thanksgiving Day at Mitchel Field, Long Island, was Lieut. C. C. Mosley of the United States Army Air Service, who piloted the Verville-Packard American-built airplane to victory. The engine of this machine is the Packard 600-horse-power engine, designed by Col. Jesse G. Vincent. The Verville-Packard machine attained a speed of 178 miles per hour, thus marking a new record for American planes and engines. The Verville-Packard airplane is at present being overhauled at McCook Field and certain changes are being made in the gasoline feed, in the belief that when these are completed it will be possible to reach a speed well beyond 200 miles an hour and thus break all records.

**A Small-Airplane Contest.**—In view of the political situation in Italy preventing the entrants from having their machines ready in time, it has been decided to postpone the international competition for the Mapelli Cup. At this writing the contest has perhaps taken place, although we await such news with interest, together with the details. This cup has been offered by Mr. Luigi Mapelli for an annual competition for aircraft "having a wing-spread of not more than 6 meters over all, and driven by engines of total stroke-volume up to 4,585 cu. mil. inclusive." The competition is a speed one, and each succeeding race is to be for twice the distance of the preceding one. For this year the course selected is over a distance of 182 kilometers. At each of the designated points on the course the competitors will have to come down for three minutes, and the machine which completes the course in the shortest time will win the cup.

**A German Gliding and Soaring Competition** was recently held in the Rhön district by the League of German Model Aircraft and Gliding Clubs. The meeting was marred by one unfortunate accident, resulting in the death of the well-known pilot, von Loessl. This was due to breaking in the air of the elevator of his glider. A number of monoplanes and biplanes were entered, some of very novel design. Many of the entries had comfortable seats and landing gear, as distinguished from the old-time gliders in which the operator's legs swung below the planes, ready to take up the strain of a hard landing, often at the price of serious injuries. The longest distance covered by the gliders was 1,830 meters, with a duration of 142.5 seconds. That record was made by Klemperer, with a height of 330 meters. The apparent gliding angle of Klemperer's flight was one in thirty-one.

**Airplane and Seaplane Design Prizes.**—The British Air Ministry offered prizes totaling £64,000 for the best designs of airplanes and seaplanes; half of this sum was for large airplanes, £16,000 for small airplanes, and £16,000 for seaplanes. In the airplane competition only £24,000, or one half of the total, has been awarded, because the results "show less radical advance in general design than had been anticipated." In the seaplane class it is stated that a great advance in design and efficiency has been shown, and because of the excellence of the machines the second prize has been increased to £8,000 from the original £4,000, which was offered. Each machine had to have accommodations for four passengers, and the tests included rising from and alighting on both water and land, as well as making a figure-of-eight course on the water around two buoys placed within a rectangle measuring 200 by 100 yards. It is understood that a full technical report on all classes of the machine will be issued.

## Science

**A Reservation for the Australian Aborigines.**—The commonwealth of Australia has taken steps for the preservation of the aborigines of that country, and has assigned a tract of public lands in the Northern Territories as reservation for the tribes. It includes the Mann and Petersen Ranges and practically the whole of Lake Amadeus. The governments of South and Western Australia have set aside adjoining areas for the purpose of this reservation.

**Public Health Engineering Abstracts.**—A new feature of the *Public Health Reports*, issued wekely by the U. S. Public Health Service, is the occasional publication of a batch of abstracts of current literature relating to sanitary engineering. The following list of titles from a recent instalment of abstracts gives an idea of the scope of the undertaking. All abstracts are short. "Protection of Surface Water Supplies Against Contamination," "Activities of the Division of Engineering of the Illinois Department of Public Health," "Nitrate Content of Certain Waters Considered Bacteriologically Safe," "Design of Aspirators for Sterilizing Waters," "The Water Supply of the American Expeditionary Forces," "Report of Sewage Experimental Investigations at West New Brighton, N. Y."

**The Crop Protection Institute.**—Under this name, and with the advice and assistance of the National Research Council, has been organized an association for studying insect pests and plant diseases and improving methods of fighting these scourges of agriculture. The temporary secretary of the Institute is Mr. Harrison E. Howe, chairman of the Division of Research Extension of the National Research Council, while the board of trustees includes nine scientific men representing leading organizations interested in crop protection and four representatives of industrial concerns manufacturing chemicals and appliances used in combating crop pests and diseases. There is always room for research in plant pathology. It is estimated that, in a recent year, the black-stem rust alone was responsible for the loss of 180,000,000 bushels of wheat in this country.

**A New Cryogenic Laboratory.**—One of the most interesting pieces of scientific news that has recently come from Washington is the announcement by Dr. R. B. Moore, of the Bureau of Mines, that his Bureau is installing a first-rate laboratory for low-temperature research. The immediate purpose of establishing the laboratory is to obtain data needed by the Government helium plants, but, says Dr. Moore, "there is a strong desire that this laboratory shall be of material use to science in general, and that it may be possible later on to make arrangements for its facilities to be used in special cases by men outside the Government service who are specially equipped for such work." The equipment includes two four-stage Norwalk compressors with a capacity of 75 cubic feet of free air per minute, which will be used for making liquid air and other purposes. There is also a vertical submarine type Norwalk compressor with a capacity of 12 cubic feet of air per minute to be used in connection with a liquid hydrogen cycle, and a similar compressor of smaller capacity for use in connection with a liquid helium cycle. The staff will include four technical men and two mechanics, under the direction of Dr. Moore.

**The Campaign Against Rats.**—A special conference of state health officers with the U. S. Public Health Service was held in Texas last August to consider the bubonic plague situation, and the resolution was adopted that "a nation-wide effort should be made to determine as accurately as possible the presence or absence of rodent plague in all ports of entry and principal centers of railway freight transportation in the United States," and further that the present situation in the southern states "should be the occasion for inaugurating a nation-wide campaign against rodents on economic as well as public health grounds." In this connection the Public Health Service has published full instructions concerning rat surveys and rat proofing and has drawn up a model building ordinance with a view to eliminating rats. It is a fact not generally recognized that, apart from their well-known powers of spreading disease, rats impose a very serious economic burden upon the community. In this country it is estimated that their depredations amount to $167,000,000 a year. The rat population of the United States is conservatively estimated to be equal to the human population, and similar figures have been published for Great Britain, Denmark, France and Germany. The annual upkeep per rodent is estimated at $1.80 in Great Britain, $1.20 in Denmark, and $1.00 in France. (These are pre-war figures.)

## Industrial Efficiency

**Pulverized Lignite** or brown coal is being used as fuel in Australia. The lignite is mined in either shafts or open cuts, the coal crushed on the spot to egg size, then hoisted to the air-drying tipples at the surface by bucket conveyors. After drying about seven days, the coal is relieved of practically half of its moisture content and is ready for final treatment. This final process, which should be undertaken near the place where the fuel is to be used, consists of again crushing the coal—to about ½-inch mesh—after which it is passed through a rotary drier, where the moisture content is reduced to about 10 per cent. The fuel is then pulverized, separated by air, and stored in bunkers.

**Germany's Modified Barter System.**—One development of the impasse in import and export business between Germany and other countries growing out of the depressed value of the German mark has come as a modification of the barter system. Arrangements have been made by various British interests whereby there is practically an agreement on the part of German manufacturers to manufacture goods for account of the British or other interests out of raw materials furnished by the latter and for a percentage of the goods as a commission or profit. Most of the work in this line has been done by British cotton interests who have arranged to furnish German cotton mills with raw cotton and take from them cotton yarn manufactured therefrom, the German manufacturers retaining a portion of the yarn as their payment for the use of their plant, of their labor and fuel outlays, and other costs of manufacture.

**An Inserted-Tooth Metal Saw** which promises to meet a long felt demand has been invented, and is being placed on the market. This saw was especially designed to meet the requirements for a saw to cut structural iron, I-beams, channels and stock with thin walls that could not be cut so successfully with other saws of similar design, because the pitch or spacing of the teeth was not fine enough to keep two teeth in the cut at all times in this work. This new saw through its arrangement and closer spacing of teeth provides for smoother running and eliminates chatter which is often noted where the teeth are placed farther apart in the plate. It is a fast cutting saw and is fitted with as many teeth as it is possible to fasten securely into the plate while retaining the perfect alinement of teeth and strength of plate necessary to stand up and cut true. These saws are being made from 10 inches in diameter with kerf of ¼ inch and maximum of 40 teeth, to 50 inches in diameter, 15/32 inch or 7/16 inch kerf with 210 teeth as the maximum number.

**Europe's Interest in American Advertising** is steadily growing. Certain American periodicals have lately been asked by European manufacturers about rates, circulation, and other data of interest to prospective advertisers. Most of these inquiries are from Holland and Germany, although not a few are from France and Great Britain, with a lesser number from Italy. European manufacturers are beginning to face a serious over-production so far as their home market is concerned, and it is altogether to be expected that they are casting covetous eyes toward the Amerian market. They evidently intend advertising their wares in the very near future. Because of the rate of exchange, they can undersell American products in many different fields while still making a handsome profit for themselves—at least under the existing tariff. We have already seen the new European efforts in cameras and lenses, certain chemicals and drugs, print paper, toys, books, fine instruments, photographic supplies, and so on. Are these but the vanguard of a formidable European invasion?

**Industrial Machinery in France and Belgium.**—"Europeans have overestimated their capacity for rehabilitating their industries. . . . American cooperation applied to the reconstitution of essential producing industries would provide a considerable market for American industrial machinery and at the same time would insure raw materials and more work for European machinery factories. . . . More needs to be done to gain the confidence of European industrialists." The foregoing are the expressed opinions of Trade Commissioner Charles P. Wood in a report on industrial machinery in France and Belgium just published by the Bureau of Foreign and Domestic Commerce of the Department of Commerce. The publication is known as Special Agents Series No. 204, "Industrial Machinery in France and Belgium." Copies can be purchased for 10 cents from the Superintendent of Documents, Government Printing Office, Washington, D. C., and from the district and coöperative offices of the Bureau of Foreign and Domestic Commerce located in different cities.

# Our Lagging Gold Production

## Reasons Why Less of the Precious Metal Is Being Produced Now Than for Many Years Past

By Arthur L. Dahl

WILL the world run short of gold? This is a question that is bothering our economists, and the answer is not as reassuring as it might be. Individuals have grown accustomed to the absence of the golden eagle from their pockets, but they had the vague comfort of believing that there was a big pot of gold somewhere in the world, and that being a basic metal it would be impossible to lose any permanently. But an analysis of the world's statistics shows that gold production is not keeping pace with the demands, and that unless its use for the arts and sciences is restricted, there will not be enough to support the tremendous expansion of credit which is based upon the gold standard.

In the last 425 years of which we have records of gold production, the total amount of the precious metal taken from the earth and added to the world's supply was only a little more than seventeen billion dollars. Of this production over half was mined in the last 25 years, during which period the average annual production of new gold is approximately $375,000,000. Of this the United States produces less than $100,000,000, and this production is gradually diminishing from various causes.

The quantity of gold used in the arts has increased by leaps and bounds until now it amounts to about $40,000,000 annually in the United States alone. It is estimated that there is about $9,000,000,000 in gold in the national and bank reserves of the world, and of this amount the United States holds over one-third, or an increase of more than two billion dollars since 1900.

In spite of the fact that gold is distributed in every continent and is mined in about 60 different countries, its production has never been considerable in any one locality, with a few possible exceptions. The gold fields of the Transvaal, South Africa, are the heaviest producers, and now yield about 40 per cent of the world's gold, as against about 20 per cent from the United States. The Transvaal mines employ 200,000 natives and 20,000 white men, or more than are employed in all the metalliferous mines in the United States. In the United States, gold production, although constantly diminishing, has been kept up to present figures largely through the operation of gold dredges, which extract the grains of gold from lands incapable of being profitably mined by other methods.

The gold output of the world seems to have passed its zenith and to be on the decline. Existing ore bodies are being worked out and few new ore bodies of importance have been added to the gold and silver producers in recent years. Much of the gold now produced is taken from low-grade ores that are profitably worked only because of the improved technique in mining and metallurgy developed by engineers. The yields and costs vary in different districts and in different mines in each district. The greatest gold producers have been mines of low or moderate yield per ton, but with great mass occurrence and good conditions for economical working. For example, the Homestake mine in South Dakota, which has been working since 1875 and has produced over $147,000,000, has operated entirely in low-grade ore averaging not over $4 per ton, and yet this mine has made a profit of over $40,000,000, or 27 per cent of its output. Another famous mine, that of the Alaska Treadwell group in Alaska, has crushed and treated 26,000,000 tons of ore, yielding $63,000,000, or $2.37 per ton, and at a cost of $1.42 per ton. Another Alaska mine is reported to have worked over 2,000,000 tons of ore giving a yield of less than $1 per ton, and yet made a profit, but this is only possible by a combination of unusually favorable natural conditions and a most efficient organization backed by ample capital.

Since the beginning of gold mining in the Witwatersrand district, South Africa, in 1887, there has been produced there a total of $2,571,992,355 with a gross profit of over $600,000,000, but while production is holding up pretty well in this district there is no present likelihood of developing new and unknown deposits, and a steady decline is looked for in the African fields.

Australia reached the maximum of its production in 1903, when $87,000,000 in gold was mined, but since then it has gradually declined, until in 1916 the returns were only about $39,000,000. Canada, too, has declined from a production of $28,000,000 in 1900 to less than $15,000,000 in 1917. Russia and Siberia in 1914 mined about $28,000,000 of gold, but in 1918 this figure had dropped to $12,000,000. The same story is told of all other gold-producing countries, including the United States, for in 1919 the world produced but $350,000,000 in gold—$31,000,000 or 8.1 per cent less than for the preceding year. With this loss for 1919, the total amount of the decline in the world's gold production for the past four years was $119,000,000 or over 25 per cent.

The United States has been, probably, the largest gold-producing country on earth, for up to 1917 it had mined a total of $3,912,,708,000. In 1915 it produced over $101,000,000, but in the following years it has gradually declined in production until in 1918 the gold amounted to only $68,646,700. There are six States and the territory of Alaska that have for the last six years produced approximately 90 per cent of the gold of this country. They are, in the order of their production, California, Colorado, Alaska, Nevada, South Dakota, Arizona and Montana. For the last two years all of these States have shown marked declines in the amount of gold produced, and the lode or quartz mines have shown the greatest falling off, largely due to the increased cost of mining, compared with the fixed value of the gold recovered. California and Alaska have maintained their output largely through the operation of gold dredges, which, though feeling the effects of the increased cost of production, had to keep operating on account of the maintenance of their organizations and the indirect loss that would be sustained by

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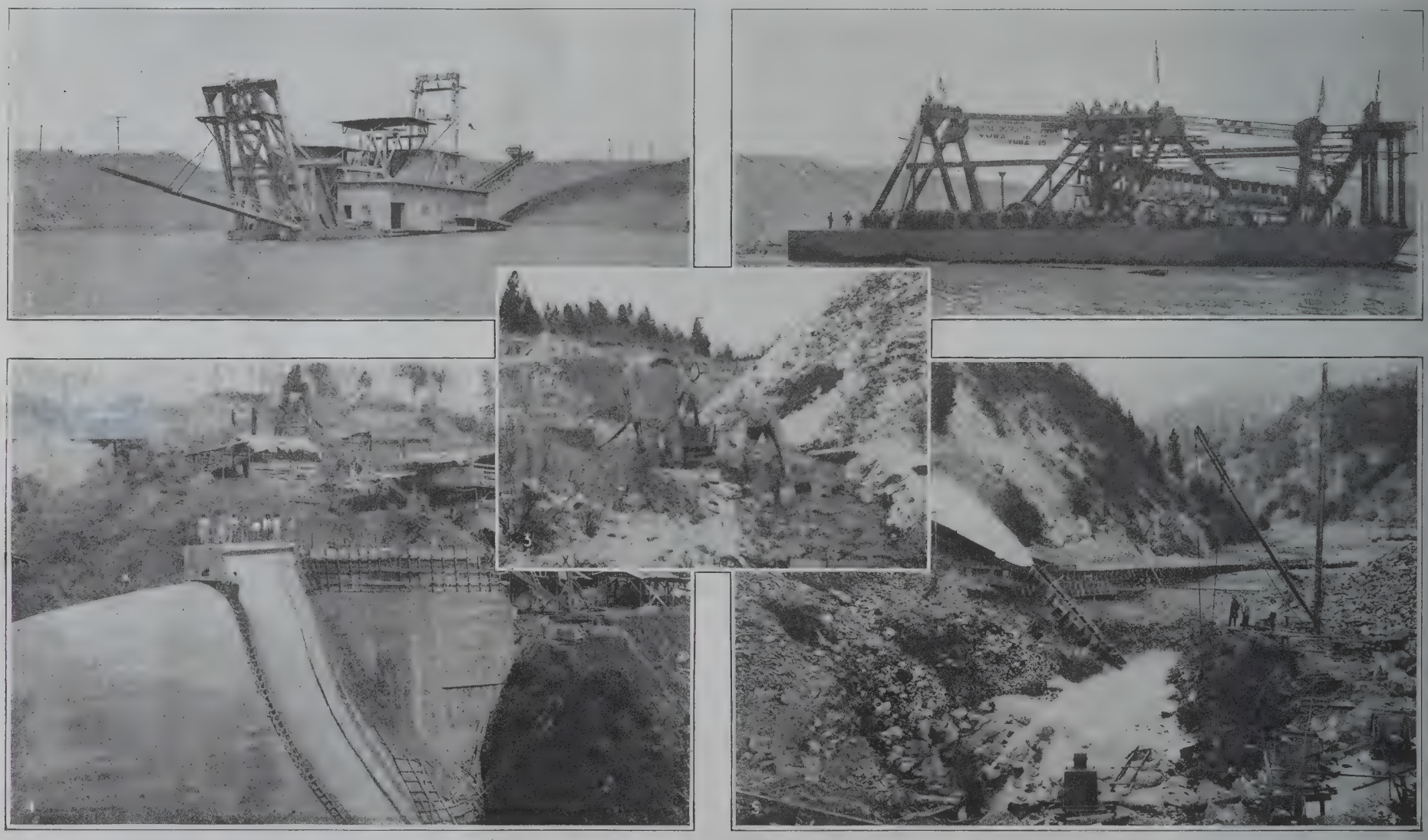


1. A gold dredge at work in California. 2. Launching of one of these huge boats that wipe out hills and valleys in search of the yellow metal. 3. The old way—placer mining by hand in the style of the 49's. 4. Dam constructed in connection with gold-dredging operations in British Columbia. 5. Hydraulic mining, in which the hillside is washed away, to be treated for gold on a magnified placer basis

**Some of the modern methods by which gold mining is placed on a quantity basis in connection with large deposits of low grade**

*Left:* Where the canal takes a slight drop. Note the great masses of water passing through this narrow cut. *Right:* The Whalen diversion dam and headworks

**Some of the construction involved in the North Platte irrigation, and already completed**

## The North Platte Project Today

**By J. F. Springer**

A PORTION of the Fort Laramie Unit of the North Platte irrigation enterprise was thrown open on March 5, 1920, to men who had been in the Government's military service in the Great War. There were only 79 farms offered for entry, and yet 9,000 men sought information as to the offer and about 1,500 ex-soldiers actually assembled at Torrington, Wyoming, to compete for the land. Some 10,000 acres were actually allotted. These facts illustrate two things: (1) That the experience of earlier settlers on reclaimed territory at other points has been good, and (2) that ex-soldiers are rather eager for farm homes.

The North Platte project, viewed as a whole, is one of the greatest anywhere. It is already guaranteeing 14,000 farms against drouth by means of its 12,000 main canals and ditches. The crops thus provided for are worth annually some $80,000,000. The value of these irrigated lands runs up to $200,000,000. These statements represent what has been accomplished. The recent competition at Torrington illustrates the fact that the enterprise is still being developed. This great project contemplates, in fact, the absolute control of a great river and the utilization of its waters to just about the limit of the possibilities.

The controlling feature in the project is Pathfinder Dam. This structure cost upward of $1,200,000 and has been and is one of the notable dams of the world. It is 218 feet high, and has a length along the crest of 600 feet. It stands in a canyon where the great river passes between granite cliffs that are almost vertical, they are so steep. The dam was constructed largely of the granite found on the spot. Nevertheless, from the distant railway (C. B. & Q. R. R.), the construction machinery, the general supplies, the necessary cement, and so on, had to be painfully transported across the intervening desert. The power plant was located high up on the cliffs above the site of the dam. Cableways strung across the canyon assisted in handling the work. Excavating to a depth of 12 feet, the workmen came upon bedrock. Big cranes or derricks were stationed down at the bottom of the canyon and along the sides. And a great tunnel was cut for the purpose of passing the waters of the stream during construction. However, real floods had to be dealt with, and these simply swept over the work, leaving it intact.

Dynamite, pluck and engineering knowledge and equipment proved themselves competent to attack and solve this problem, and to do it economically as well. The lake created by damming the North Platte at this point has a storage capacity of 1,025,000 acre-feet—enough water to flood the whole State of Rhode Island to the depth of a foot. It is said, in effect, that the capacity is only a trifle less than the combined storage capacities of the Wachusett, New Croton and Ashokan reservoirs. The masonry of the dam amounts to 60,400 cubic yards. Despite the fact that the site of this dam is located 45 miles from the nearest railroad, the cost of construction was very moderate. The entire river is controlled. This was a big conception. The Platte is a very long stream rising in the mountains of Colorado and flowing through a large part of Wyoming and dividing the whole State of Nebraska lengthwise. The head-waters lie between the Medicine Bow and the Sierra Madre ranges, near the Continental Divide in north Colorado. On the other side of this Divide, but farther north and west, are the head waters of one fork of the Snake River. The one sends its waters to the Gulf of Mexico and the Atlantic Ocean, while the other contributes to the Pacific Ocean. The North Platte and Snake figure in great irrigation enterprises.

**Lower face of the Pathfinder dam, showing the discharge of 6,500 second-feet**

Pathfinder Dam is located far up in the valley of the North Platte at a point some three miles below the location where the Sweetwater River joins the main stream. This is in central Wyoming in a very elevated region. This may be understood from the fact that

(*Continued on page 640*)

**Measuring the hardness of rock by means of its resistance to grinding**

## How Hard Is a Rock?

**By S. R. Winters**

THIS is a question which appears to be quite as empty and meaningless as another inquiry, "How sour is vinegar?" Rocks, however, vary in quality as well as other substances of less pronounced characteristics and in road building it is essential that only the choicest specimens be selected. To the farmer who is ridding his estate of stony obstructions, rocks have no pereferential rating, the entire unassorted formation being objectionable. Builders of highways classify them with respect to their relative hardness, toughness and binding power.

Clearly, physical properties of rocks are not to be determined at a cursory glance, the material entering into the construction of macadam roads undergoing exacting laboratory requirements as a guarantee of its resistance to the wearing action of traffic, especially iron-tired vehicles. A machine in use in the laboratory of the United States Bureau of Public Roads literally separates the brittle rocks from the hard ones, setting its seal of approval upon the latter. Hardness, as it applies to rocks used in constructing roads, is that quality which successfully resists the tendency of vehicles to convert into dust fragments of rock forming the wearing course of a macadam road. Toughness implies ability to resist fracture under the pounding pressure of traffic, while binding power indicates the capacity which dust of a rock possesses or develops by contact with water for welding or cementing the larger rock fragments together. Such a quality is the tie that binds when the shearing action of traffic is spending its force, a condition especially desirable in water-bound macadam construction, where it is relied upon to maintain the integrity of the wearing course as the road surface is shaved away by vehicular traffic.

The machine, shown in the accompanying photograph, reflects the relative hardness of rocks. It consists of a circular steel disk, which is revolved in a horizontal plane by bevel gear driven by a pulley. A brass grip clutches the test specimen, the clasp being held in a vertical position over the steel disk by inserting it in the sleeve. The latter is of such dimensions as to constitute a sliding fit, permitting free vertical movement but forestalls a sidewise tendency of the grip. Crushed quartz, the laboratory wearing material, is fed on to the disk through a funnel, the lower end of which forms an opening one-fourth of an inch in diameter. The sleeve is so situated that the center of the grip, when in position, will be 26 centimeters from the center of the rotation of the disk. A galvanized-iron hopper, located under the disk, receives and conveys away the used sand.

Crushed quartz, as the abrasive agent, is screened for passage through a standard sieve with 30 meshes to the linear inch and is retained on a standard sieve having 40 meshes per linear inch. Commercial sand of this specification is not easily available, so it is a practice to specify a sand not more than 5 per cent of which will be retained on a No. 30 sieve and not more than 25 per cent of which will pass a No. 40 sieve. A core 25 millimeters in diameter and 10 centimeters long is cut with a diamond drill from the specimen subjected to the hardness test. Once thoroughly dried, the piece of rock is placed in the brass grip of the testing machine, leaving one inch projecting from the lower end. The grip is inserted in the sleeve, the lower end of the specimen resting on the steel disk. The funnel is filled with sand and the machine operated until the lower end of the rock has worn away, down to the plane of the disk.

(*Continued on page 640*)

# Why the Cliff Dwellers Vanished

## A Modern Industrial Hazard that May Have Existed in Prehistoric Times

By Frederick L. Hoffman

THERE can hardly be a more interesting speculation than the racial origin and the rise and fall of what must once have been a considerable population of a region now marked only by the ruins, the shrines and the temples brought to light by patient excavation throughout vast areas of the great Southwest. It hardly admits of a dispute that the original cliff-dwellers, as they are most familiarly known, had passed away long before the Spaniards visited that region and, beginning with about 1759, inscribed their names on Inscription Rock, now fortunately a national monument. That the aboriginal life was extensive in area and that the population was considerable in numbers is made evident by the many ruins, nowhere so clearly indicated as in Mesa Verde Park in southeastern Colorado, just north of the New Mexico line. On the topographic survey map of Mesa Verde Park five hundred and seven ruins are indicated, differentiating cliff-dwellings and remnants of the Pueblo type. Two hundred and two of these ruins are located within a distance of five miles from Cliff Palace, and within a radius of ten miles from this central point may be found no less than ninety-five per cent of the entire colony of identified ruins. Of the five hundred and seven distinct ruins fifty-two and a half per cent are located on the left-hand side of the canyons, as opposed to forty-seven and a half per cent on the right-hand side. The entire area is two hundred and eighteen square miles in extent, including a portion of the Southern Ute Reservation and the great Montezuma Valley, which touches the southern border of Utah.

This area is not symmetrical in its relation to what was probably the center of religious life and industrial activity, readily identified by the ruins of Cliff Palace and Sun Temple, which lie just north of the State line. It is, therefore, difficult, if not impossible, to estimate even approximately the probable population of this area, since it is practically certain that further excavations will reveal numerous ruins in adjacent territory, as yet but superficially explored. It is most regrettable that practically all the accounts of archaeological explorations in the Southwest should be wanting in maps useful for the purpose of tracing known ruins with certainty, both as to location and type. There would seem to be no excuse why such an elaborate work as the report on the "Explorations in Northeastern Arizona" by Kiddle and Guernsey should be entirely wanting in a map, without which all estimates of the probable population must be a matter of mere guesswork opinion. As an admirable illustration of the type of maps useful for the purpose, although on a scale hardly sufficient for exact identification, reference may be made to the really extraordinary dissertation on ancient communities in the American Desert, published by Prof. Edgar L. Hewett, in French; Geneva, 1908. (*Les Communautes Anciences dans les Desert Americain*).

### Primitive Stone-Working Technique

The condition of these ruins, many of which have only been brought to light during very recent years, particularly under the direction of Prof. Jesse Walter Fewkes, of the Bureau of Ethnology, is indicative of a relatively high degree of attained civilization by a population thoroughly representative of the late Stone Age. An immense number of stone implements have been found, suggestive of the conclusion that the stone work of these ancient inhabitants was the predominating industry, universally carried on as a matter of paramount necessity by a considerable portion of the male population. The processes employed in shaping or manipulating stone materials by our early Indian tribes have been learnedly discussed by numerous writers, but for the present purpose it will be sufficient to quote from a contribution by Professor Holmes to the "Handbook of American Indians" the statement that there were used "(1) fracturing processes, variously known as breaking, spalling, chipping, flaking; (2) crumbling processes, as battering, pecking; (3) incising or cutting processes; (4) abrading processes, as sawing, drilling, scraping and grinding; (5) polishing processes."

We have in this description all the elements typical of an industry which in modern times has been materially modified only by the introduction of iron and steel tools on the one hand, and pneumatic cutting methods on the other. The labor in the primitive stone industry must not only have been much more arduous and exacting (for years must have been necessary to produce some article of special merit), but it is also safe to assume that the industry must have had a most important bearing upon the health, physical strength and disease liability of the cliff-dwellers.

That the ancient stone work was in many respects a craft, requiring a much higher degree of specialized individual skill than the modern mechanical processes, is made evident by a further observation by Professor Holmes, who remarks that, "In shaping blades a suitable piece of brittle stone, preferably a flattish pebble, bowler, flake or fragment was selected, and with a hammer-stone of proper weight, usually globular or discoidal in form and generally not hafted, chips were removed by means of vigorous blows about the periphery, alternating the faces. The utmost skill of the operator was exerted to cause the flakes to carry from the point of percussion near the edge across and beyond the middle of the sides of the stone, failure in this resulted in the formation of a high ridge or node on one or both faces of the blade, which effectually prevented the proper development of the form."

### The Atmosphere of the Stone Workers

The foregoing statement emphasizes the conclusion that in ancient stone work the processes, the personal exposure to health-injurious conditions and the after-effects may possibly have been even more serious than is the case at the present time. The effects of stone work vary, of course, according to the chemical and microscopical nature of the dust inhaled in considerable quantities during the working processes. While granite dust is probably the most injurious, limestone, bluestone, and slate dust are unquestionably less harmful. Thus far no scientific observations appear to have been made a matter of record, clearly disclosing the nature of the different rocks out of which the ancient cliff-dwellers carved their dwellings or by laborious manipulations made the tools indispensable to the needs of primitive life. In many sections the remaining work indicates the extraordinary amount of skill and painstaking care in the cutting and surfacing of stones used for walls or in the building of community dwellings, underground kiwas, etc. The best illustrations of ancient dwellings or cliff-alcoves (originally some back rooms of talus pueblos) are contained in Report No. 5 of the Archaeological Institute of America on the "Excavation of Tyuonyi, New Mexico" by Prof. Edgar L. Hewett. This paper was followed by an equally interesting report, including numerous illustrations of rock dwellings with floor plans and tables of dimensions and in Paper No. 10 on the "Excavation of El Rito de los Frijoles." Both of these papers were issued at Santa Fe, N. M., in 1909 by the Archaeological Institute of America.

It is not generally known that the disease resulting from the continuous and considerable inhalation of stone dust is not primarily pulmonary tuberculosis, but fibroid lung disease, which may or may not, according to the chance of exposure, result in a subsequent tubercular infection. In other words, even if pulmonary tuberculosis did not occur among the ancient cliff-dwellers, there cannot be the slightest doubt but that fibroid lung disease must have prevailed to an extraordinary extent among the stone-workers during the period when the stone industry had reached its highest development or near the date when the ancient civilization had practically come to an end.

*IN many parts of our Southwest it is clear that we have the remains of what once must have been a rather numerous and certainly a partially civilized race. But the cliff-dwellings are empty, and their builders vanished—so long vanished, in fact, that even among the pueblo dwellers who succeeded them little or nothing is known of them and their fate. It seems plain enough that these later people did not drive their predecessors out by force; had they done so, they would certainly have preserved this heroic event in their history through song and story. A rational answer to the question "What became of the cliff-dwellers?" is attempted in this article by Dr. Hoffman, and whether one agrees with his conclusions or not, it must be admitted that a really rational answer is what he gives.*—THE EDITOR.

### Dwellings Carved from Solid Rock

But there is another aspect to this question to which attention may properly be directed. Anyone who carefully examines into the rock dwellings, particularly as observed in Frijoles Canyon, must needs have been amazed at the enormous amount of labor involved in the literally carving out of the solid rock of the many large and small rooms, or cliff-dwellings, extant at the present time. These rooms are almost invariably dark and the dust exposure during the process of working, as well as later, during occupation, must have been considerable, if not enormous. After carefully examining into many such dwellings (for I have not had the dust either chemically or microscopically examined), there remains no doubt in my mind that the health-injurious consequences of the stone industry, both in its industrial and home-building aspects, must have been, in the long run, disastrous to health and life.

According to Professor Holmes: "Owing to differences in the composition of the rocky strata, the natural shelters occupied by the cliff-dwellers are greatly varied in character. While many are mere horizontal crevices or isolated niches, large enough only for men to crawl into and build small stone lodges, there are extensive chambers, with comparatively level floors, and with roofs opening outward in great sweeps of solid rock surface, more imposing than any structure built by human hands. These latter are capable of accommodating not merely single households, but communities of considerable size. The niches occur at all levels in cliffs rising to the height of nearly a thousand feet and are often approached with great difficulty from below, or, in rare cases, from above. Where the way is very steep, niche stairways were cut in the rock face, making approach possible."

I have given this extract also in its entirety, to convey as clearly as it is possible a picture of the ancient domestic life of these people, due to the practically unbelievable natural difficulties overcome in countless instances, which would seem to defy the power of human adaptation. But there must have been continuous exposure to stone dust in all essential operations, from road-building to home-building, and from the making of corn-grinders to spear-heads and battle-axes. As said by Professor Holmes: "The masonry is excellent and while the stones were rarely dressed, they were carefully selected, so that the wall surface was even and in some cases a decorative effect was given by alternating layers of smaller and larger pieces and by chinking crevasses with spalls.

"The walls were sometimes plastered inside and out with clay paint. The doorways were small and squarish, and often did not extend to the floor, except an opening or square notch in the center for the passage of the feet. The lintels were stone slabs, or consisted of a number of sticks or small timbers. Windows or outlook apertures were numerous and generally small."

### A Passion for Death-Dealing Labor

All of this would seem to indicate an almost unbelievable amount of manual labor on the part of a remnant of what must once have been an extensive civilization. Another essential fact, which requires to be kept in mind, is as pointed out by Professor Holmes, that "The cliff-dwellings to which the term 'cavate' is applied, are not built, but *dug* in the cliffs." The ruins of today are of course but the survival of vast pre-existing building operations, and, as said by Dr. Prudden "Excavations which have been made in several places show that buildings themselves of great age have been made on the top of still older structures." These digging and building processes must have involved a very considerable, if not disastrous, exposure to health-injurious dust. Even at the present time the dwellings contain dust accumulations, which would seem to indicate that the process of dust inhalation must have been practically continuous and universal. While modern stone-cutting is more injurious, on account of the use of pneumatic tools, there are at least the advantages of qualified medical aid, of more nourishing food, of better conditions of home life and prolonged periods of rest, with

(*Continued on page 641*)

## The New President of the American Association

**By Marcus Benjamin Ph.D.**

THE American Association for the Advancement of Science has had three wonderful permanent secretaries, each of whom has enrolled his name for all time among those of the great men on the roster of American Science. The able Lovering gave place to the genial Putnam, who in turn passed the mantle on to the brilliant Howard. Each of these three men was rewarded at the close of his term of office by an election to the highest place in the gift of the association.

Leland Ossian Howard is the son of Ossian Gregory and Lucy Dunham Howard, and was born in Rockford, Ill., on June 11, 1857. In early boyhood his parents settled in Ithaca, N. Y., where he was prepared for college and then naturally entered Cornell, in which university he pursued the modern course and graduated as B.S. in 1877. For a year he continued at Cornell, following post-graduate work preliminary to medical studies, including special courses in entomology—a subject to which he had been devoted as a child—under John H. Comstock, now the Nestor of American entomologists.

His ability in this branch of natural science was apparent from the beginning, and a vacancy in the entomological service in the U. S. Department of Agriculture becoming available led to his appointment as assistant entomologist to the Bureau of Entomology in 1878, with which service he has since continued, becoming chief in 1894. During these years he has also held the office of Honorary Curator of the Division of Insects in the U. S. National Museum, the duties of which are scarcely secondary to those of his office in the Department of Agriculture. Dr. Howard has also served as consulting entomologist to the U. S. Public Health Service since 1904 and at present he is also a member of the Executive Committee of the National Research Council.

During these many years rich with the fruits of patient research and the practical applications of their results, he himself notwithstanding the heavy duties of his administrative work, has made time to study parasitic insects and their utilization as enemies of crop pests. The introduction of the European and Japanese natural enemies of the gipsy moth and the brown-tailed moth was done at his suggestion and under his direction. Also, he deserves special credit for his work on medical entomology, such as the carriage of disease by insects. His writings on mosquitoes and the house fly have been of very great assistance to persons engaged in the fight against those disease-bearing insects, and the early measures against mosquitoes in Havana and Panama were based upon his published recommendations.

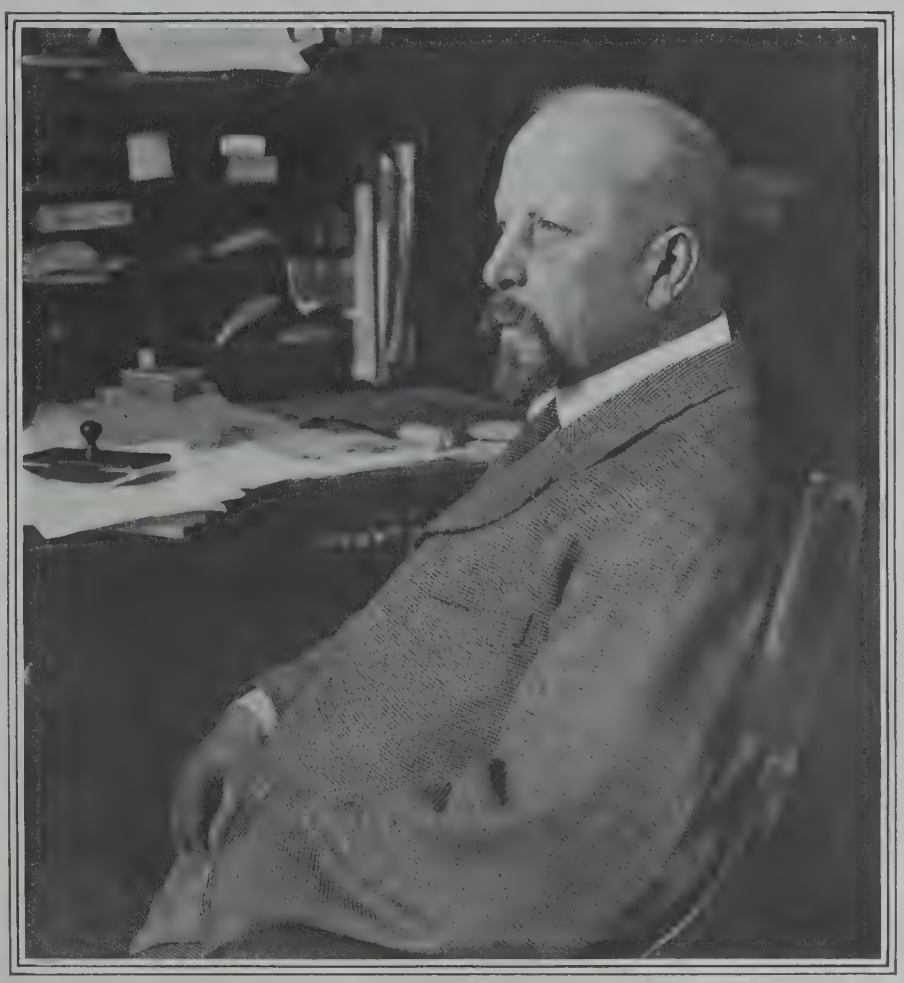
His remarkable industry and untiring energy is further manifested in a scientific bibliography that comprises over eight hundred separate titles, and he is the author in book form of "Mosquitoes—How They Live," etc. (1901); "The Insect Book," (1902); and "Mosquitoes of North America," (1912). Besides these he was for some years the editor of "Insect Life," a technical journal published by the Department of Agriculture, as well as preparing definitions in entomology for the Century and Standard dictionaries and writing articles on his specialty for the New International Encyclopedia and other works of reference.

His ability to present in popular language the technicalities of his specialty led to lectureships at Swarthmore College and at the post-graduate school of Georgetown University. He has lectured frequently before the Brooklyn Institute of Arts and Sciences and in 1901 gave a course before the Lowell Institute, in Boston, Mass. The first Sir Sanford Flemming Foundation lecture in Toronto was given by him, as well as the public lecture before the Royal Society of Canada in 1903.

His work has not failed to receive deserved recognition. The degree of M.S. came to him from Cornell in 1883, and that of Ph.D. from Georgetown in 1896, while in 1911 he received the honorary conferment of M.D. from George Washington and of LL.D. from Pittsburgh. Also, during 1900-5 he was an alumni trustee of Cornell.

Besides having held the presidency of the Association of Economic Entomologists (1894), the Biological Society of Washington (1897-8), the Cosmos Club (1909), the Washington Academy of Science (1916), the Entomological Society of America (1919), he is a member of the American Philosophical Society, the American Academy of Arts and Sciences and the National Academy of Sciences. In addition to corresponding membership in a number of European academies and learned societies, he is an honorary member of the Entomological Societies of London, France, and Stockholm, of the Royal League of Agriculture of Portugal, the Association of Economic Biologists of Great Britain, the National Society of Acclimatization of France, and one of the two American members of the Academy of Agriculture of France.

Dr. Howard became a member of the American Association at its Cleveland meeting in 1888 and a year later was advanced to the grade of Fellow. In 1893 he was chosen secretary of Section F in Zoölogy and served that section again in 1895 as its chairman and once more in a similar capacity in 1897. He was elected permanent secretary of the association at the Toronto meeting in 1898 and from that time until the close of the meeting in 1919 continued to fill that important office. His efforts in building up the association have succeeded in more than quintupling its membership and his many friends were glad to testify to their appreciation of his merits by the unanimous acceptance of his name for the presidency in 1919.



**Dr. Leland Ossian Howard, the new president of the American Association for the Advancement of Science**

## Plant Movement and Radiant Energy

THAT a sunflower will turn on its stalk sunward from dawn throughout the entire day is known to everyone; and that branches of trees grow more luxuriantly southward than northward, is a matter of common observation. Similar evidences of the heliotactic response of growing plants to radiant energy will readily occur even to persons not especially interested in plant physiology. On the other hand, the writer has found, by questioning numerous friends and acquaintances, that few persons who are not botanists are aware of the very active response of cut (detached) branches of trees, especially trees of the genus *pinus*, to radiant energy, whether proceeding from a common electric-light bulb or from the sun. In this connection, the following experiment, demonstrating the "motor-power" of these two manifestations of energy acting on plant cells may be of popular interest, since the phenomenon may readily be produced by anyone at will.

Place three or more stems and twigs of any "evergreen" species of tree (pine, hemlock, cedar, etc.) in a vase or jug, with or without water, and suspend the vessel by means of twine or ribbon from a shelf or a projecting "arm," so that it may move without obstruction, near a window with sunward exposure. Let the center of gravity of the overhanging twigs be somewhat away from the direct sunlight. It will then be seen that the sunlight will pull the green twigs, together with their container, away from the center of gravity, but that the pull is not sufficient to hold the plant in this position, and it will return almost immediately to its original station; but only to be pulled sunward again within a moment or two. The effect, then, is an almost continuous movement to and from the sunlight, with short pauses between; neither gravity nor radiant energy being competent to hold the plant still.

When evening comes, an electric bulb of at least sixty-watt power, placed even a few degrees on either side of the center of gravity, will produce the same constant swing to and fro. Tobacco smoke in the air seems to increase the arc of the plant's movement. The sap drying at last, the movement ceases; addition of water brings renewal of motion.

Now try to conceive the actual internal mechanism of this constant fluctuation produced by sunlight or electric rays. Is it *heat* that draws the plant toward the light? If this were the explanation, a sad-iron heated to the electric bulb's temperature would secure the same motion. Try it. Is the rhythmic movement caused by the "light"—does electric or sunlight *pull* a green bough when separated from the living tree? Light is not regarded as a substance, as matter, because experiment proves that darkness can be produced by the addition of two portions of light. Such an experiment is not possible with substances, as usually understood. How, then, can it attract, pull, these several twigs?

That light can push or repel matter is well known. Such a repulsive force was attributed to sunlight by Clerk-Maxwell (1870), when he propounded his electromagnetic theory of radiant energy; and this mechanical pressure was experimentally demonstrated and measured in 1901 by Peter Lebedew, and soon thereafter his work was carried forward by Nichols and Hull. The repulsive pressure of light has been fairly well explained. But how can the light force green twigs to turn (carrying the vessel) in its direction as against the pull of gravity?

Possibly some of the readers of this magazine can give an explanation of the phenomenon that will really explain. To say that the plant cells are *hungry* for the lumic energy necessary for the splitting of the molecules of carbon dioxide, so that they may, through the agency of the chloroplastids, feed on the atom of carbon in $CO_2$, building up the highly complex substance called starch, and are thus naturally heliotactic—is to state a fact rather than to explain it. Undoubtedly electronic forces are at work in the process, and somehow force the cells lightward; but how?

Leibnitz long ago pointed out that force, or the exhibition of energy, is the most important and fundamental phenomenon in the universe. That force we now know to be electric energy; but we do not yet know what electric energy is. We do know, however, to a certain extent, the conditions under which it becomes manifest to man's senses, and how it can be harnessed for man's uses. But we do not know how it is harnessed and utilized for the plant's uses. The energy hidden in the cell of a living plant, enabling it to convert the inorganic into the organic—into that enormously complex material represented by the formula $C_6H_{10}O_5$ —is at present quite beyond man's comprehension.

## Fire-Proofing Cotton

A PROCESS has been devised for treating baled cotton with a chemical compound which renders it flame and spark proof and at the same time apparently provides an inch or two of cotton in condition to aid in rapid drying without deterioration in case a bale is exposed to weather. On an average, 20,000 bales of cotton are destroyed by fire before the crop is marketed and most of this loss can be traced to flash or spark fire. Cotton stored in suitable warehouses would be evidence of a progressive step, for there is probably no crop of so great value that is treated with so little thoughtful consideration.

# Disposing of the Sewage

## A Typical Plant at Mount Vernon, N. Y., with Special Features of Interest in Overhead Distribution

By Sanford G. Plumb

1. Water test of the nozzle and inverted spraying disk for underflow distribution. 2. Rear view of filter bed sheds and tank discharging oxidized effluent into the river. 3. Overhead gravity distribution, with streams of sewage falling on spraying disks

**How Mount Vernon takes care of its sewage to such good effect that it does not seriously pollute the river into which it is discharged**

UNTIL the plant at Mount Vernon, N. Y., was built, no system for sewage disposal using the overhead distribution by gravity had ever been installed. This system had been developed at the sewage experiment station of the Massachusetts Institute of Technology, and it was on the basis of the satisfactory results here indicated that it was adopted by Mount Vernon, in connection with the disposal of sewage from the more elevated parts of this decidedly hilly little city. For the lower sections of the town, the sewage enters the works in the usual fashion, 26 feet below the level of the screen chamber and septic tank, and is brought up to that level by two electrically operated pumps of 25 horsepower each. The total volume thus handled is 1,000,000 gallons; to this the gravity system adds 1,500,000 gallons. The combined mass flows through the screen chamber and septic tank to the overhead distributing system of pipes above the filter beds.

On the satisfactory results obtained at Mount Vernon has hinged the adoption of this system of sewage distribution in several other cities; and for this reason the Mount Vernon plant is the scene of frequent inspections by officials from other States. The plant has been in successful operation eleven years, which should be sufficient to establish the principle as a sound one.

As an introduction to the subject, we may say something of the theory of sewage disposal by trickling, borrowing the subject matter from Metcalf and Eddy on Disposal of Sewage. Liquefaction, the change of insoluble substances into soluble ones, has been described as a result of bacterial activity through enzymes. Certain species of bacteria appear to liquefy in a much greater measure than others; the aerobic bacteria are reinforced by enzymes. The process of oxidation of free ammonia, first to nitrites and then from nitrites to nitrates by separate and distinct organisms, is called nitrification. That nitrification is due to bacterial action is apparent from the fact that it is checked or stopped entirely by low temperature, by heating to the point of sterilization, and by certain chemicals inimical to the life of bacteria. Furthermore, temperatures favorable to bacterial development cause nitrification to proceed rapidly.

While some enzymes have been known for years, even before the organisms secreting them were known, there is still no knowledge of their chemical composition. They possess the peculiar property of not being destroyed by the process in which they take part. Like the organisms which secrete them, they are sensitive to heat and poisons, becoming inactive on exposure to temperatures about 50 degrees to 80 degrees C. and to disinfectants like formaldehyde and mercurial chloride. The final decomposition, the process which yields the energy for cell life, must take place within the cell. Investigations of recent years demonstrate that these processes are caused by enzymes.

The trickling filter is capable of converting putrescible settled sewage into stable effluent, not subject to putrefaction under the most exacting conditions. In trickling filter-beds, the sewage is applied to the surface as uniformly as possible by sprinklers or other devices. Experience has demonstrated that usually the trickling filter-beds are self-cleansing.

The settling solids not removed by preliminary sedimentation are retained mechanically in the pores of the filters. The colloidal matter adheres to the surfaces through attraction and absorption and the dissolved organic matter is absorbed by the bacterial jelly or acted upon directly, probably both processes occurring. The bacterial jelly coats the stones from top to bottom of the bed, in mature condition, and appears to perform its functions in relays, that at the top acting upon so much of the organic matter as its capacity will permit, that of the next stratum below attacking the substances passing by the upper one, or perhaps emitted from it, partly oxidized, and so on to the bottom, where the oxidized sewage falls through the floor grating into the underground drainage system, the organic matter being converted into humuslike material or resolved into carbon dioxide and other soluble and gaseous products and the nitrogenous substances being oxidized with products of ammonia, nitrites and nitrates.

Knowledge of the particular organisms present and the work which each species does is lacking, but it is certain that the processes are chiefly aerobic, for failure to supply air is quickly reflected in the inferior quality of the effluent.

The periodic storage and disgorging of solids by the trickling filter is one of its most important and interesting features. When sewage first reaches the public sewers, it is "fresh" and contains free oxygen, so that aerobic bacteria thrive. The bacterial activity rapidly depletes the oxygen, which may become exhausted, as sewage, unless vigorously agitated, absorbs oxygen from the atmosphere very slowly. After a lengthy flow through sewers, aerobic bacteria, though present, are fast losing their activity. Such sewage is classed as "stale" and at the same time the faculative anaerobes begin to increase in number and activity.

The depletion of oxygen is particularly marked if the sewers are of such length that several hours elapse before the major part of the sewage reaches the outlet. Soon the last traces of oxygen disappear, the sewage becomes very dark, or even black, and hydrogen sulfide or other sulfides are formed.

When sewage stands for a long time or flows very slowly through tanks, the anaerobic organisms gain the ascendency and ammonia, marsh gas, carbon dioxide, hydrogen, nitrogen and other gases may be formed, as the complex organic compounds are broken down into simpler ones. This is a reduction or septic process.

While oxidation goes on to some extent during anaerobation, it is usual to consider aerobic conditions essential to oxidation which approaches completeness. Oxidation of organic matter is effected by many aerobes, including those producing nitrites and nitrates.

It will be deduced from the generally accepted theory so concisely expounded in the foregoing extracts not only that an even distribution of the liquefied sewage over the surfaces of the filter-bed is essential so as not to flood the interstices, but that it needs to be violently agitated to renew the supply of oxygen by aeration; hence the importance and signifi-

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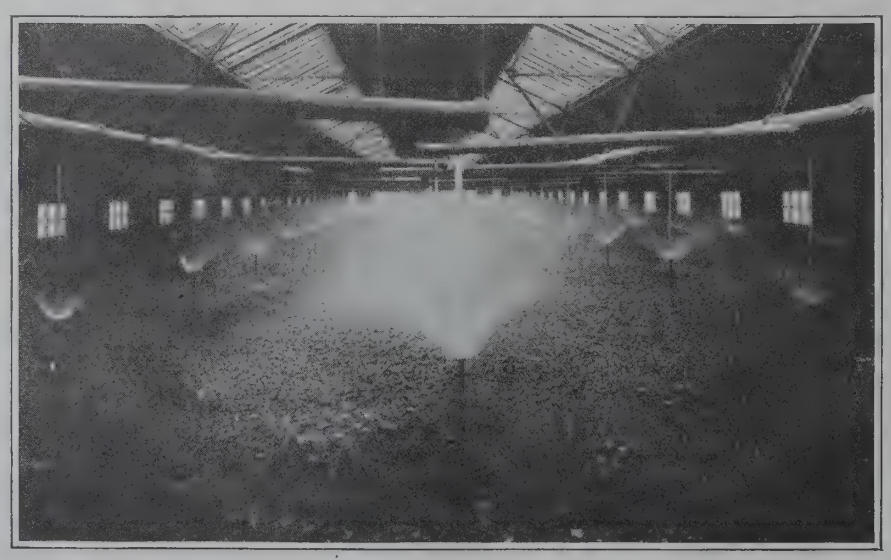


**Spraying the sewage over the filtration bed**

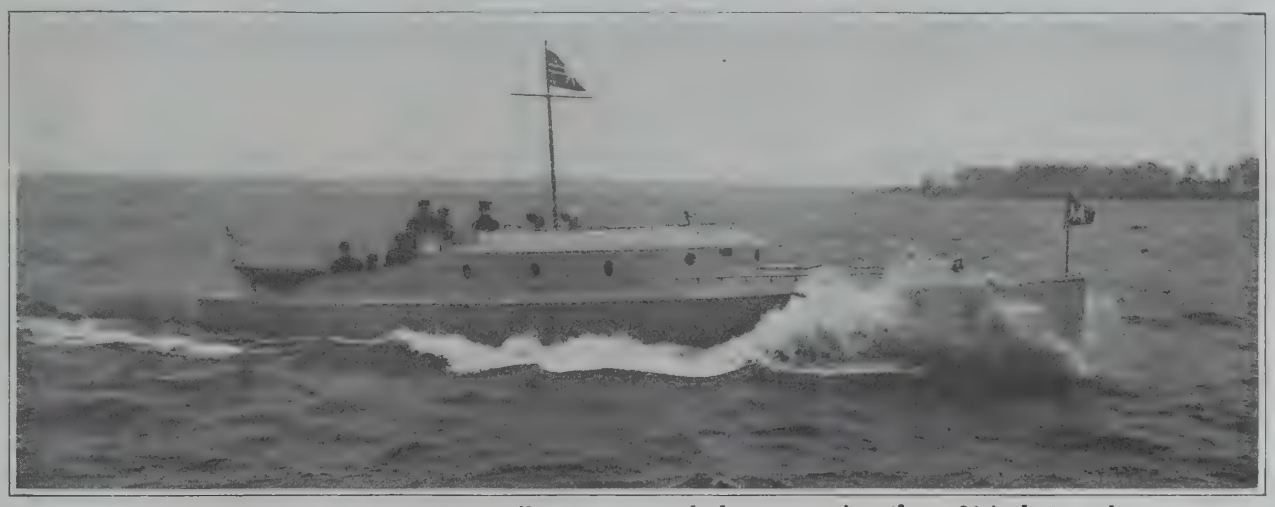
## A New Type of Torpedo Boat

IT is an interesting study to trace the profound changes which important successive engineering developments have produced in the design of naval ships, changes which in some cases have been distinctly of a revolutionary kind. Particularly is this true of motive power. The advent of the practical marine steam engine stripped the fighting ship of its towering fabric of masts and sails, and so greatly increased the maneuvering power and speed of the warship that the picturesque frigate and three-decker disappeared from the seas forever.

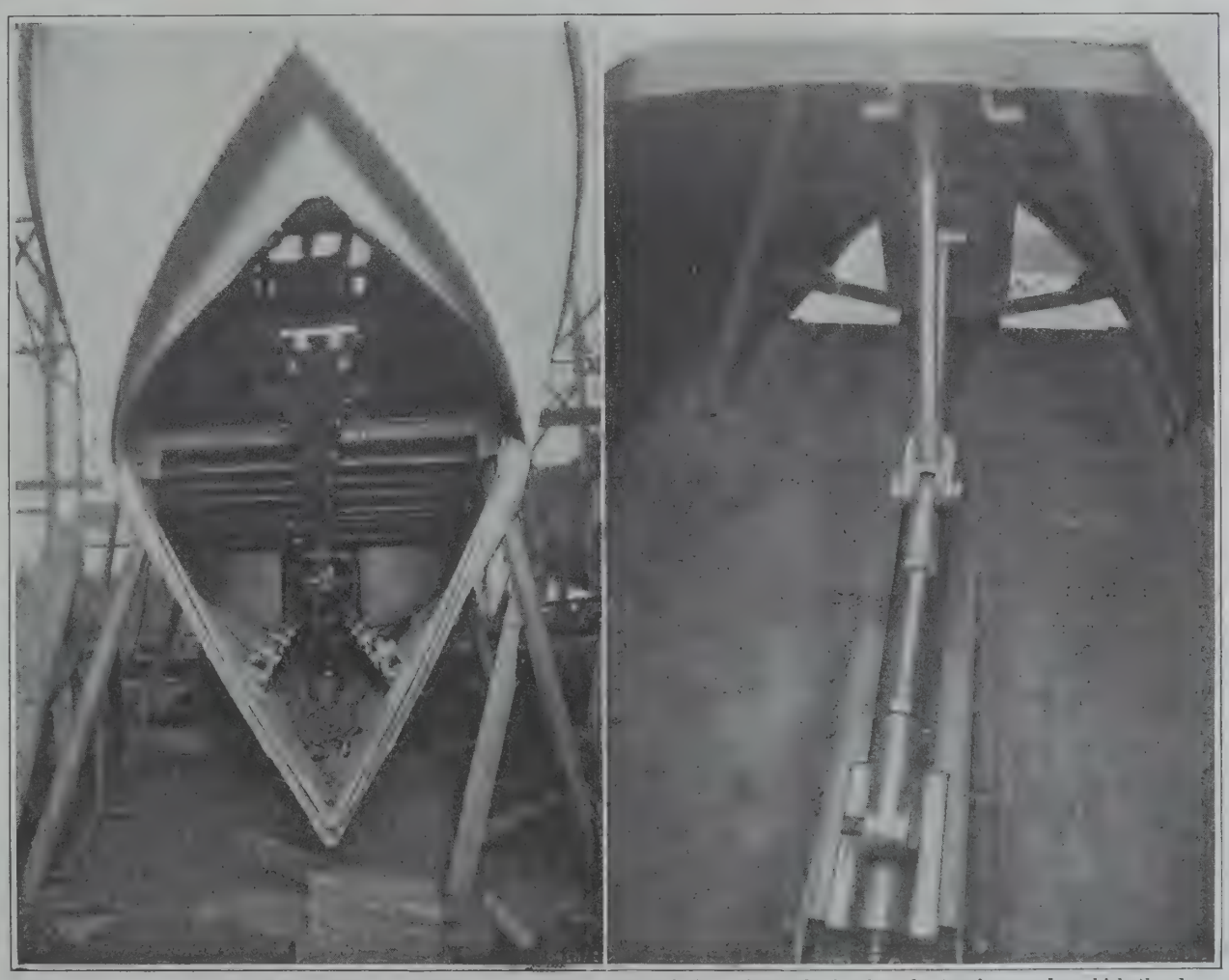
Similar in kind, though not in degree, are the changes which have been wrought by the introduction of the internal combustion motor and the use of oil fuel. As steam power reduced the visibility and increased the speed of warships, so oil fuel and the oil engine are reducing the visibility of warships by getting rid of telltale smoke and rendering possible a marked increase of speed in the larger ships and a phenomenal increase of speed in the smaller craft.

It was only a question of time when the high-speed motor boat would begin to attract the attention of the naval designer and lead him to seek some way in which he could utilize in naval craft the astonishing speeds achieved by this type of boat. The official speed of 70 miles an hour, maintained by "Miss America," in the recent contests for the Harnsworth cup, was the culmination of motor boat speed, which had been advancing by leaps and bounds during the past ten years; and it was inevitable that a serious effort would be made to utilize a modified form of motor boat in those fields of naval warfare in which a combination of invisibility and high speed is of prime importance.

The accompanying illustrations represent a most promising effort in this direction. The boat is the product of civilian effort, and it is the third of its type to be built by its inventor, Mr. W. B. Shearer of this city. One of these illustrations was taken a few minutes after the boat had been christened by the wife of the inventor and launched on the Sound at City Island, in the presence of a party of guests consisting mainly of ranking officers of the Army and Navy. As soon as the little craft was clear of the ways, the engines were started and she went through a number of evolutions at speeds of 15 to 20 miles an hour. Because of the fact that the engines were new, no attempt was made on these tests to reach the maximum speed of 32 miles an hour. The dimensions of the boat are—length 58 feet and beam 9½ feet. The twin engines develop 600 horse-power. The "Sea Hornet," as she is called, was designed to meet the conditions which the inventor considers to be indispensable for successful torpedo attacks, namely, small size, invisibility, high speed of approach and retreat, and mass attack.



The "Sea Hornet," a 58-foot, 30-mile motor torpedo boat, carrying three 21-inch torpedoes



*Left:* View of bow, with the torpedo firing chamber open. *Right:* View looking forward, showing the toggle gear by which the door of the firing chamber is opened when firing the torpedoes

**Details of the torpedo-firing mechanism of the motor torpedo boat "Sea Hornet"**

In spite of the high stage of development to which the torpedo has been brought, and the great range which the latest types can cover, the experience of the late war has shown that to hit a ship at ranges of 7,000 yards and over is more a matter of luck than good shooting. In the great battle of Jutland, torpedoes were discharged by the hundreds; but the percentage of hits was exceedingly small. The explanation is to be found in the impossibility of close approach by destroyers, because of the destructive fire of the heavy anti-torpedo batteries carried by the modern battleship. To make sure of a hit, torpedo craft should approach to within 1,000 or 2,000 yards range, something which is impossible for the modern destroyer, which is a big ship, 1,200 to 1,500 tons in displacement and over 300 feet in length.

The "Hornet" with its speed of 30 knots and over would make its rush for the enemy end on and in great numbers (it can be built for $30,000 to $40,000), and so low do the craft lie in the water, and so great would be the change of range as they approached, that it would be impossible for the gunners on the enemy ship to change and set their sights quickly enough to make sure of a hit. Even were a barrage laid down, the boats would be so quickly through it that the chances of disablement would be small.

A remarkable fact in connection with these little craft is that they can carry three of the largest 21-inch torpedoes, which are carried upon bronze rollers bolted to the floor of the boat. The first torpedo is carried in the firing chamber at the bow; the second is below and between the twin engines; and the third below the deck of the cockpit, each being in its own separate watertight compartment. In firing, a large valve is opened and the bow compartment is flooded. By means of a threaded shaft connected to a powerful toggle gear, the lower half of the bow swings up and back and houses within the boat. The starting lever of the torpedo engines is then tripped, and the torpedo leaves the bow under its own power. Two powerful pumps then clear the firing chamber of water, and the second torpedo is pushed forward into the chamber ready for a second attack.

Motor torpedo boats open up a wide field for the use of the torpedo. They can be carried on special motor-boat ships corresponding in size and speed to airplane carriers, which would accompany the main fleet, the boats being launched for mass attacks on the enemy's battle line. They would form a valuable auxiliary to our coast defenses. As matters now stand, a great increase in the range of naval guns has put the larger part of the artillery of our coast defenses at a serious disadvantage. When these fortifications were designed and equipped, naval ranges were less than one-half what they are today; and it would be possible for a fleet of modern ships to lie at a range entirely beyond the reach of a large portion of our shore batteries, and bombard them without the batteries being able to make any reply. It is considered that the maintenance of flotillas of these motor torpedo boats at or near our principal coast fortifications would effectively prevent any such long-range bombardment, since they would effectually break up the enemy's line and render it impossible to carry out any accurate and sustained attack.

## An Explanation of Leaning Chimneys

BETWEEN the wagon builder, alternately wetting and drying a board to bend it to the desired shape, and the house chimney, grotesquely leaning toward the east, brick masons say there is similarity. The leaning chimney is a subject on which even the doctors disagree, but the theory referred to seems the most plausible.

Chimneys lean toward the east. A little observation anywhere will prove this. Even the best-built affair of brick and mortar, acquiring age, often begins to lean. Various theories are advanced, but the explanation of alternate wetting and drying seems the best.

Chimney walls collect more or less moisture during the night, on all sides. Now if the broad side of the chimney is toward the east, and if the sun strikes that part of the chimney first, as it will, that side dries out much quicker than the north or south side, or the western side. In time of rainfall, the east side ordinarily is dried the quickest. This general condition has the effect of pulling the chimney toward the east.

# A New American Industry

## How the Making of Toys Has Been Established on a Solid Basis in This Country

By Harry A. Mount

WITH foreign-made toys again available to American buyers and prejudice against the "Made in Germany" mark fast disappearing, what is to become of the American industry which sprang up overnight in 1914? For the first time since the war our toy makers are beginning to feel the effects of competition. Several of the mushroom concerns already have been forced out of business. But the industry as a whole, investigation reveals, is well intrenched against competition from foreign lands and undoubtedly will survive its crucial test. The war has added a new American industry.

Before 1914 about ninety per cent of the toys sold in the United States were made in foreign lands. The ten per cent of American toys sold were, as a whole, an inferior product. Toy sellers thought of games in terms of Spear, the one great German toy house. The highly colored and exquisitely finished German games had no American rival. The finest dolls came from Germany and France and mechanical toys were almost certain to bear the German trade-mark.

Today our games are as good as any that came from Spear; we are making better dolls than ever came from abroad; and our mechanical toys are far superior to the foreign product. It was once the habit of American toy-buyers to make a mid-summer trip to Europe to order toys for the holiday trade. For the last five years these junket trips have been cut off. Undoubtedly much of the foreign ordering now is being done by buyers who are more anxious to see battle-scarred Europe than to find better toys than they can secure at home. But American manufacturers are not asleep. They are already shipping thousands of dollars worth of American toys to Latin-America, which once was supplied almost entirely by Germany. They are even selling toys in England and France and at least one firm is shipping dolls to Berlin.

But why are American toys the best in [illegible] today?

The toy industry naturally falls into three distinct divisions and it will be necessary to consider each independently. The largest-selling toy line is dolls. That is because dolls, as miniature reproductions of our own selves, have the most universal appeal. Every girl must have her family of dolls, but boys too play with them and even men and women buy thousands of dollars worth of novelty dolls each year.

The first requisite of a good doll is a beautiful face, with the texture and fine coloring of a real head. German bisque heads came nearest to perfection in former days and bisque dolls were standard. When the supply of German dolls was suddenly cut off there was a demand for dolls which existing American manufacturers could not begin to supply. As a result small cloak and suit makers and a variety of similar manufacturers turned their establishments into doll factories. They made very creditable cloth bodies but in attempting to supply heads the American makers "fell down" flatly. They failed to recognize that it is the beautiful child's face which makes the appeal in a doll. Artists of indifferent ability were engaged to model the heads, poor clay was used for the bisque, bad colors were used. The first flood of American dolls was therefore very disappointing.

But out of some 125 doll factories that sprung up to meet this new demand, a few have recognized that doll making is a fine art and their success more than compensates for the first poor results. German practice has been discarded and the doll you buy today for your little girl is a thoroughly American little miss. Her head is not of brittle bisque but is of a non-breakable composition. The texture of the finish and the coloring, however, are just as fine as that of the German bisque. The bodies are of the same material or are of cloth stuffed with ground cork, but in either case they are more substantial and better made than the imported bodies. Both bodies and head have been designed by the best artists to be found. The faces no longer present the blank, staring "baby-doll" look, but real character is graven in them. Probably the best selling doll in the world today is modeled after a famous cartoonist's conception of a real little girl. She doesn't wear just a one-piece dress of cheesecloth, but her clothes are designed and made just as carefully as if she were a real little girl.

There are several compositions and processes for making dolls but the one most widely adopted consists of pressing a mixture of sawdust, resin and glue into hot molds, producing half of the head or body. The two halves are then glued together, baked, trimmed, dipped in specially prepared enamels and finally finished by artists.

And so while the American doll makers are apparently losing ground just now because many of the small factories are closing, the foundation for a distinctly American doll industry has been laid and no foreign country at present is able to compete with the product.

Next to dolls in appeal in the toy line are the games. Two or three American game makers have been long established, but it must be frankly admitted that their product had failed to reach the degree of excellence obtainable from foreign makers.

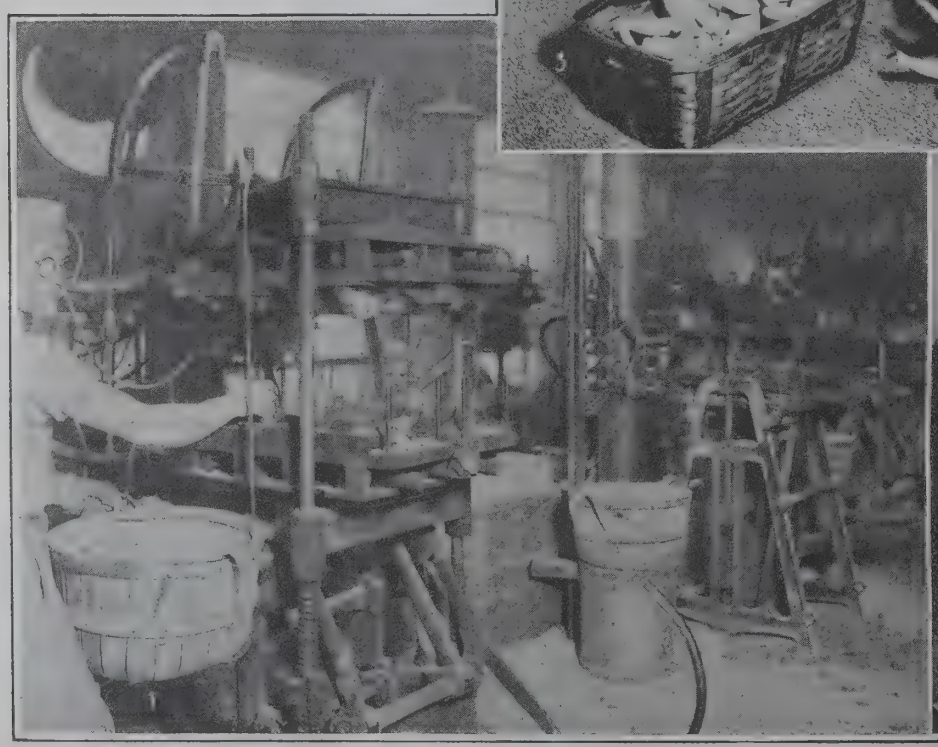
These factories have doubled and tripled their output since 1914. But they have done more than that. They have been searching for better manufacturing methods, better colors, better materials, better designs and as a result their product is just as good today as the finest to be obtained elsewhere. Added to this are American methods of quantity manufacture so that in the United States our game manufacturers have every advantage over foreign competitors. There seems little chance that American games will ever be superseded where they have gained a foothold and their selling range is being constantly widened.

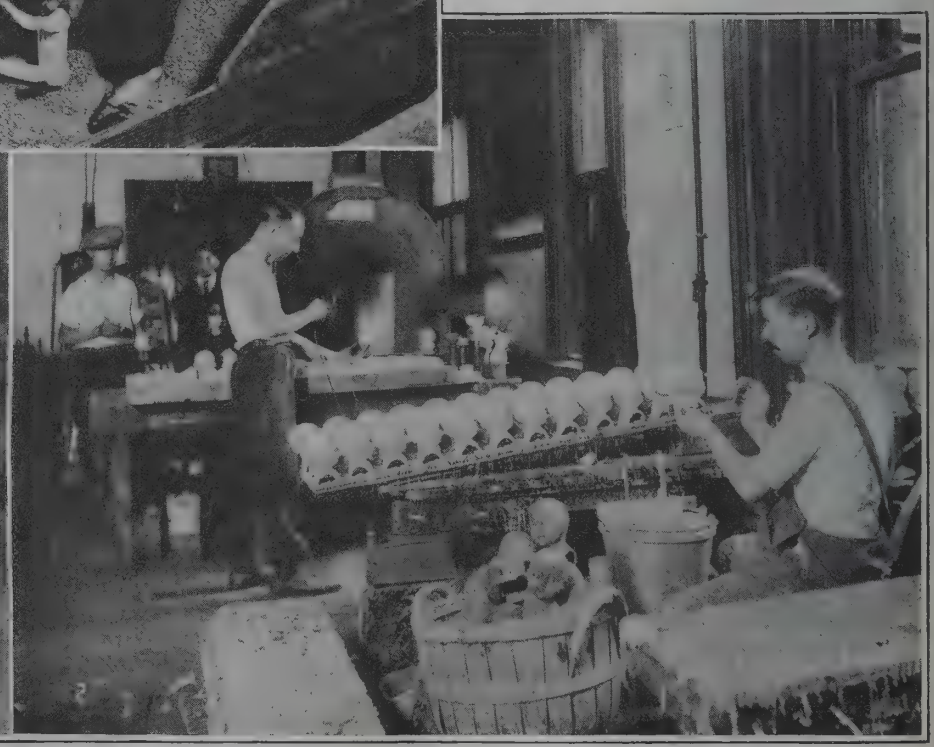
The third line, mechanical toys, is most firmly established of the three. The foreign-made toys were brightly colored and finely finished, but very frail. The mechanisms were poorly designed and once broken they could seldom be repaired because parts had to come across the sea.

Take toy trains, for instance. Nearly all of these were imported before 1914. Now there are two American makers whose products have come to be the world standard. Not only are the trains they produce just as finely finished as any others, but they are built with the precision of real trains, with well-designed and robust mechanism. Parts for these trains are quickly available.

Sheet-metal toys which formerly were made in Germany have been re-designed and the American-made toys look just as well and are much stronger. Yankee

(*Continued on page 642*)



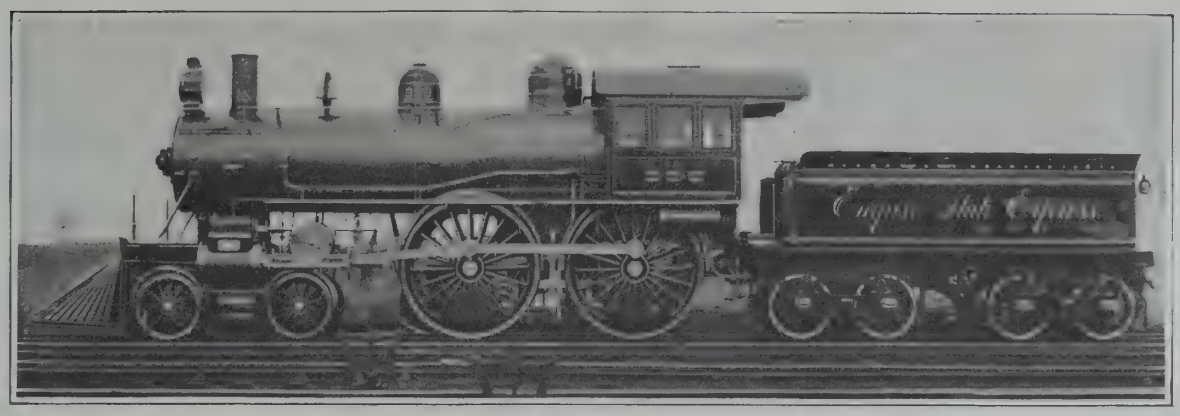


1. The hot molding machine for making doll parts. 2. The fabrication of doll's heads. The man at the right is dipping the heads; the one at the left is air-brushing on the pink cheeks. 3. Stuffing cloth bodies with their ground cork filling

**The manufacture of dolls in great numbers as it is being carried on in America today**

## Old 999 Still in Service

**By Ralph Howard**



**Engine 999 as she appeared in her heyday, when she hauled the Empire State Express at a net running speed of sixty miles per hour**

CONSIDERABLE circulation was given, recently, to a statement that No. 999, the famous engine that hauled the Empire State Express for so many years, had been sent to the Port of Missing Engines, otherwise known as the scrap heap. This is not in accordance with the facts, for the famous locomotive is still in service on the railroad that it helped to make famous. In this connection the New York Central has supplied us with material on the history of the old engine, which many readers will find of great interest.

No. 999 was built entirely at the construction shops of the railroad in West Albany. She was completed in 1892, and went into regular service in front of the Empire State Express early the next year. Built for light, fast running, she was ideal for this light, fast train. She was equipped with special 81-inch drivers and 40-inch truck wheels, and was the first engine to have brakes applied to her front trucks. It was with her doing the hauling that the train made its much disputed record of 112.5 miles per hour. The scheduled time for the 439 miles run between New York and Buffalo was eight hours, with four stops. Deducting all stops, etc., the schedule called for a net speed throughout the run of just about sixty miles per hour. Owing to heavy traffic and other conditions, these exacting demands on the Empire have been modified, and her schedule now allows her nine hours to make the run.

It is to be emphasized that, while engines today are built much heavier than the 999, their drivers are not so large. This puts them at a double disadvantage when it comes to a question of pure speed; for not only must a greater piston speed be developed to cover the ground at the same rate, but the pounding on the track is vastly greater. The engines of today will make their maximum speed with a far longer and heavier train than their predecessors of twenty years ago—the 999 would not begin to make 60 miles per hour with nine or ten cars; they would make just about as good speed as the old fellows did, in fact, if the track were such as to permit it; but if we attempted to run the Empire State Express of today at any such speed as 100 or 110 miles per hour, the first curve would probably see her ditched by spreading rails. Her limit is about 80 or 85 miles on the straightaways.

After about twenty years of service of the sort for which it was built, it became necessary to retire the 999 from the main line, in recognition of the length and weight of the through trains of the new period. The famous engine was therefore shifted to the Rome, Watertown and Ogdensburg, then maintaining its operating organization more or less distinct from the big line but now known merely as the St. Lawrence Division. In 1913, after considerable alteration, her number was changed to 1086. Soon after she was shifted to the Pennsylvania Division, where she has been employed ever since, and where she is now rounding out her twenty-ninth year of active passenger service.

A glance at the record card of the old locomotive is of interest. It appears that her original cost was a mere $13,000, and that in the last thirteen years of her career she has been the beneficiary of thirteen more or less general overhaulings at a cost of some $14,000 more. This phase of her record cannot be given for her complete career, since repair sheets prior to 1908 are not accessible. The time when the famous old locomotive is no longer available for service is remote, but when it arrives, plans already under consideration will insure her an honorable post of retirement and exhibition in the Grand Central Terminal at New York. This will be a fitting terminus to the history of an engine that has contributed so largely to the railroad lore of the United States.



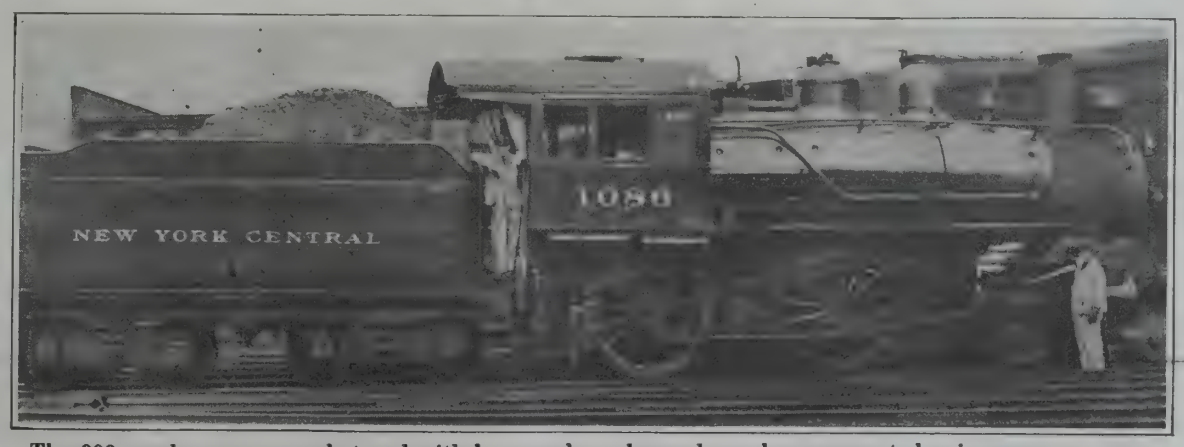
**Scraping off the coal in the open mines of the Nieder Leustiz district of Germany, by means of a giant scraper which delivers the coal into the coal cars.**

Copyright, Keystone View Co.

## Coal Mining in the Open Mines of Germany

COAL generally calls up a vision of dusky miners working far down in the bowels of the earth, laboring hour after hour in cramped quarters and faced with all sorts of danger. So the accompanying view of the activities at the open mines of the Nieder Leusitz district of Germany is of more than passing interest, because it shows one phase of coal mining that is utterly different from the accepted version—as different from conventional coal operations as the iron mining of Michigan is distinct in its field.

These barren coal mines of Germany make mining a simple matter. By means of shovels of the type here shown, the coal and admixture of dirt is scraped off the surface and loaded directly into coal cars on top of the embankment. These cars transport the coal and dirt to the plant where the larger coal is sorted out from the similar pieces and the dust, the latter being compressed into briquets.




**The 999, made over somewhat and with her number changed, as she appears today in passenger service on the Pennsylvania Division of the New York Central Lines**

## The Properties and Uses of Manjak

THE term "manjak" is applied to a variety of bitumen or solid hydrocarbon occurring on the Island of Barbados, and in Utah, Cuba, and Trinidad. The deposits on the latter island are found within a distance of three miles of San Fernando, the second largest town on the island, and within three miles of the famous asphalt lake.

In chemical composition, manjak is like asphalt. It is almost pure bitumen. Its melting point is, however, more than 400° Fahrenheit, whereas asphalt melts at 100°. In composition, it consists of 80 to 90 per cent carbon, the balance being chiefly hydrogen, with a small quantity of sulfur. It resembles coal in appearance, is odorless, hard, and brittle. It is found in thin beds between layers of clay.

The island of Trinidad is rich in this mineral resource. Its development has as yet hardly begun, and the exportations already made have been with the view of testing out the material. During 1918, exports to the United States were valued at about $3,100, and in 1919, up to October 1, they totaled 41 tons, valued at $1,900. Prior to 1900, manjak was mined on a small scale in Trinidad, but for various reasons, very little was done between 1900 and 1913. In the latter year, mining operations were resumed, and at the present time there are five shafts, one of which has reached a 37-foot bed of manjak at a depth of 400 feet. Operations could be greatly extended if there were a greater demand for the material.

It has not been found profitable to export manjak from Trinidad in the crude state as the price received, namely, $37 per ton, hardly covers mining expenses. These are increased by the necessity for careful and thorough timbering on account of the clay formation.

Compounds, made by combining manjak with mineral oil, command fair local prices which have enabled mine operations to proceed at a profit. Experimentation is still in progress with different mixtures of manjak and oil for various purposes. The manjak recently sent to the United States was for the purpose of ascertaining whether American oils would be more economical and useful for mixing with the manjak than the Trinidad oils. It is the plan to erect a plant very soon for the manufacture of manjak paints and compounds.

Manjak is rapidly increasing in use, according to the U. S. Bureau of Mines, particularly in connection with the oil industry. It is produced in close proximity to the oil wells in Trinidad. It is boiled with oils at high temperatures and converted into compounds and paints for nearly every purpose where a preservative is needed, for example, on pipe lines, boilers, chimneys, and miscellaneous iron ware, machinery, etc. It is usually applied in the liquid state, hardening into a tough, rubberlike coating. It has low viscosity, and is not affected by ordinary heat. It makes an excellent insulating material and is impervious to both air and water. In hot and damp climates, like that of Trinidad where pipe lines quickly deteriorate, their life has been prolonged for extended periods when painted with this material.

The most important use of manjak, and one wherein it has won a reputation for saving money, is in connection with rotary drilling for oil. A soft compound is used on the joints of the pipes between the casting threads and drill stem threads, and this prevents either water, sand, or grit getting into the threads, thus preserving them from being stripped or worn off. It not only acts with partic-

*(Continued on page 642)*

# With the Engineers of Industry

## *A Department Devoted to the Physical Problems of the Plant Executive*

*This department is devoted to business men, works managers, production engineers, and all other executives seeking the maximum efficiency in carrying on their work. The editor of this department will endeavor to answer all questions relating to plant equipment, factory management, and industrial affairs in general.*

### Ventilation Made to Order

IN keeping with the steady trend toward specialization in all the arts and sciences, ventilation has become a highly specialized branch of engineering. And happily so; for the subject of ventilation is one of vital importance where the general health of the workers and their general efficiency are matters of prime consideration.

Time was when ventilation was merely a matter of opening the windows and doors more or less to admit the necessary amount of air from the outside. During extremely cold weather the windows and doors were kept tightly closed, because the admission of fresh air also meant the admission of cold. As a consequence the air in such plants became quite vitiated in the course of the working day, and the workmen became drowsy, careless and inefficient. It was inevitable.

Perhaps the best proof of the value of proper ventilation is to be found in our modern theaters, where ventilating systems handle a tremendous amount of fresh air while the shows are in progress. In one of the recent installations of this sort, in a theater seating 5,500 persons, the air is changed every few minutes. Huge blowers take in fresh air and pass it down through the outlets in the ceiling and under the balconies, while smaller outlets scattered about the floor line remove the foul air. During the winter months the air is heated by passing it through steam coils, while in summer the volume of air is considerably augmented so as to lower the temperature within the theater. By exhausting somewhat less than the amount of incoming air, it is possible in cold weather to build up a static pressure, so that when doors are opened there is absolutely no rush of air into the room. In some instances something like 75 per cent of the air is exhausted through the regular outlets, leaving an excess of 25 per cent which percolates through doors and other openings and prevents draughts.

The ventilating systems now being installed in various kinds of buildings are worthy of serious consideration, since they make for the utmost efficiency. For one thing, most ventilating systems may be made to heat the largest room by passing the air through heating coils. This method of heating is highly efficient, since it keeps the heat in constant circulation. All in all, the subject of ventilation is an important one and should be considered. But before taking any action in this direction the plant executive should first consult the engineering department of the various manufacturers of blowers and other ventilating equipment. Remember, they are specialists!

### The Value of Clean Floors

IN a previous issue we had something to say about clean walls and their effect upon the morale of the workers. Now we have something to say about clean floors, which also react on the morale of the workers. Furthermore, clean floors have a certain advertising value in such plants as welcome visitors. Nothing makes for an impression of efficiency and pride in self and in product as does a clean floor.

To the end of simplifying the scrubbing of large floor areas, especially the concrete, stone or tile floors of the factory, office, theater entrance or hotel lobby, a number of electrically-operated scrubbing machines have been placed on the market during the past few years. These machines are all of a more or less similar design, consisting of a fractional horse-power motor driving an arrangement of stiff brushes in contact with the floor, and storage tanks for soap and water. A reel mounted on the wheeled cart carrying the scrubbing equipment, pays out wire as the scrubber is pushed over the floor. Any workman can scrub a large area of floor space in a short space of time with the electric scrubber. The physical exertion is practically nil. Furthermore, the scrubber produces a better job and more uniform work than can ever be done by the manual method of scrubbing. And it goes without saying that the cost is far below that of the back-breaking method.

Whether or not to use an electric floor scrubber is merely a question of the amount of scrubbing to be done. Just as it would not pay a gardener to use a gasoline tractor for cultivating his flower beds, so it would not pay anyone to use an electric scrubber in a small shop, store, office or other place. It is a question of volume of scrubbing.

### The Steel Fence Investment and Its Returns

THE day of the wooden fence about the plant is gone. Wooden fences have outlived their usefulness. They never were highly satisfactory, but for want of something better they continued in use until the advent of the present steel-post, wire-netting and barbed-wire fences.

The various systems of steel fencing are more or less designed along the same general lines. They consist of various styles of steel posts which are set directly in the ground or are imbedded in concrete, and stout steel netting. Fences of this kind protect the plant against trespassers, thieves, firebugs, and other undesirables. Indeed, the steel fence is so secure that it virtually extends the storage space of the plant buildings beyond their walls, since the yard becomes just as secure as the store rooms, as far as theft and fire are concerned. It also protects the workmen against accident by preventing their crossing dangerous railroad tracks, taking reckless short-cuts, and so on. It simplifies the handling of workmen, since it limits their entry and departure from the works to certain definite gates. All in all, the steel fence marks a big step forward in plant efficiency, both from within and without.

### Motor Drive for Operating Sashes

THE large number of sash units to be handled in many of our plant buildings has caused the introduction of motor-operated devices. The "runs" that are handled by the electric motor installation may be as great as 600 feet, consisting of a system of shafting, cables, rods and arms, counterweights and spirals, actuated by a single motor.

One system of sash operation which has met with wide favor makes use of counterweights and spirals, acting through the transmission rods and supporting the weight of the sash when open, thereby relieving the worm gearing and motors of that load. By requiring the motors only to overcome friction (and that a minimum), from 500 to 600 feet of 6-foot sash can be operated with one smaller motor. Without the spirals and counterweights, claim the designers of this system, four motors would be necessary here; or the motors would have to be much larger. Another advantage of this particular system is the uniformity of the load. Adding a spiral and counterweight makes it easy for the motor to restart the sash when stopped partly open, and gives uniform operating conditions, including speed and wear, for all points from shut to open.

### Some Gasoline Precautions

IN gasoline engine installations and where gasoline is stored, it is almost impossible to prevent slight leaks in the gasoline system, causing the oil to leak out and gasoline vapor to be formed in greater or less quantities. This alone will cause gasoline vapors to be present more or less continuously, especially in the lower spaces under subfloors, floor plates, etc. The danger of the spark necessary for the explosion is always existent and cannot be wholly eradicated. Under these conditions it is of the utmost importance to prevent the accumulation of the vapor in sufficient quantities to form an explosive mixture.

According to A. S. Baker, Plant Protection, Philadelphia Navy Yard, writing in *Safety News*, this can be done by proper ventilation, which can be accomplished by the installation of suction fans near the floor, or between the floor and the sub-floor if any exists. This fan should be run at least one hour daily and in addition at such other times as the presence of gasoline vapor is suspected or is liable to accumulate. In the small private garage, a small space cut out at the base on both sides will be sufficient to carry off this vapor.

In addition to the above, gasoline should not be used for cleaning in enclosed spaces if its use can be avoided. Take the articles to be cleaned to the open air and clean them there. However, where it is necessary to use gasoline or gasoline rags for cleaning in enclosed spaces, use only small quantities in a stoppered container, and see that the smallest possible amount is exposed to the air at one time. Also have as much ventilation in the room as is possible. Avoid rubbing or striking objects liable to generate a spark or static electricity. A good plan is to shut down all electric appliances or machinery in operation in the vicinity. Prohibit all open flames of any description in the immediate or near vicinity. Oily waste or rags should at all times be placed in a safe receptacle to avoid danger of spontaneous combustion. Empty gasoline containers should be filled with water and stored in safe places in the open air.

To extinguish a gasoline fire, one of the several leading types of fire extinguishers should be used. Sand may also be used if available, as well as a mixture of sawdust and bicarbonate of soda; even a wet blanket may be used in the case of a small fire, to smother it. Water should not be used, as the gasoline will float and the only result will be to spread the extent of the fire. There is, however, one case in which water may be used to advantage, viz.: Where gasoline floating on the surface of a stream becomes ignited, hose streams may be used simply as brooms to sweep the flames away from docks, boats at anchor or tied up at the piers, or buildings along the water's edge, which may be endangered.

### Soot and the Boiler

ANYWHERE from 4 to 10 per cent of the fuel used under a boiler in the usual way may be saved by the use of soot blowers, according to fuel engineers. When soot accumulates on the heating surface of a boiler, it builds up a greater or less layer of heat insulation between the boiler and the fire, thereby diminishing the efficiency of the fuel to just that extent. For it is obvious that a large part of the heat is lost because it is not transmitted to the water; and this means excessively high coal bills, and poor, uncertain service from the boiler. Obviously, too, high efficiency in the generation of steam is dependent upon the maintenance of the cleanest of clean heating surfaces.

A hand lance is often employed to clean the soot from the boiler's heating surface, but this method is a relic of past days of relative inefficiency. Such a method is all well and good in the case of small boilers, where the saving effected by an automatic installation would hardly offset the cost within a reasonable period of time. But in larger boilers the soot blower means a material saving in fuel costs, in some instances as high as 10 per cent.

### Keeping the Sprinkler System from Freezing

SPRINKLER systems should always be in good working order, ready at a moment's notice to protect lives and property against the ravages of fire. Under no circumstances should the water supply for the sprinkler system be allowed to freeze, for that defeats the entire purpose of such an installation at a time when fire risks are perhaps greatest.

It has remained for a manufacturer of water heaters to develop a satisfactory method of preventing the freezing of sprinkler systems. A multi-copper-coil gas water heater attached to the standpipe of any sprinkler system is said to make the latter absolutely freeze-proof. All through the long winter months it will automatically control the temperature of the water and keep it above the freezing point. The same system of heating may also be used for providing hot water for factory lavatories.

### Faster Rehandling with Less Labor

A HAND-OPERATED hoist is the means of effecting a material saving in rehandling costs, but an electric hoist effects just as great a saving again over the hand-operated type. Small electric hoists are finding wide application in many plants, both indoors and outdoors, where they are reducing to a minimum the cost of the necessary, but usually unproductive, item of rehandling. Electric hoists are generally mounted on wheels which travel on overhead rails. Two rope controls are provided, one for lifting and the other for lowering.

The latest German art — trimming shrubs to represent animals

## A Sculptor in Shrubbery

THE people of Germany are turning from war to art and pleasure. Their new art, with which we are particularly interested in this case, takes various forms such as exceptional publicity methods, odd store fronts, remarkable architecture, and bizarre landscape gardening.

The German gardener depicted in the accompanying illustration specializes in hedges surrounding large estates. He trims the shrubs in various ways so as to represent men, animals, geometrical figures, and so on. Obviously, this work calls for no mean ability in the manipulation of the shears not to mention an artistic temperament of a more or less creative type.

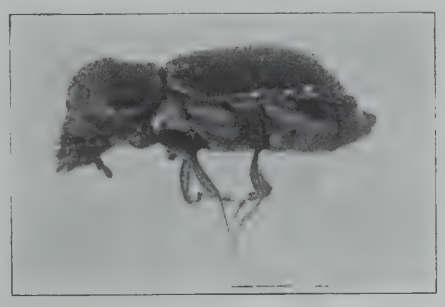
It should not be believed that the Germeans have invented anything new, as the art is quite old in England where it is known as the "topiary art," and whole books have been devoted to it.—By *A. M. Krumm.*

A simple ladder for climbing up to the bulb of a lamp post

## The "Short-Circuit" Bug of California

A WOOD boring beetle in California has found out a new way to add to the grief of the poor telephone girl. *Scobicia declivis*, for that is his only name, bores right through wood and alloyed substances which are considerably harder than lead. By boring holes in telephone cables he is putting hundreds of telephones out of commission; for when a chance rain comes along the water gets in the holes and right away somebody has a job trying to find out where the beetle has been working again.

The damage most always occurs where the cable is in contact with the ring by which it is suspended. Experimental work is being carried on with various types of suspension rings, lead alloys and chemical substances to cover the lead sheathing in order to prevent the ravages of the beetle. No practical method of control has been found yet.—By *Allen P. Child.*



The "short-circuit" bug of California, magnified about 7 diameters

## A Ladder for the Outdoor Lamp Inspector

AN inspector employed by the Harbor Board at San Francisco has devised a light ladder that he uses in climbing the lampposts along the water front for the purpose of replacing bulbs. Formerly it was necessary for the inspector to carry a large ladder from the nearest dock—a large ladder is kept in each dock for various purposes; but the new ladder, which only weighs a few pounds, is now carried by the inspector on his trips.

The new ladder, which the inspector carries without trouble, is provided at one end with a hook that is hooked into the scroll work at the top of the lamppost. The other end is strapped to the base of the post about 3 feet above the level of the ground. This eliminates the possibility of a motor truck striking the ladder and pulling the inspector from the lofty post.—By *C. W. Geiger.*

## An Interesting Drainage Culvert Constructed Through a High Railway Fill

DRAINAGE operations in Yakima County, Washington, are mainly for the purpose of reclaiming waterlogged land and areas on which alkali has accumulated through the lack of proper under-drainage or outlets for waste irrigation water. In the work of installing a drainage outlet for 10,000 acres of land in the county a culvert 100 feet in length in a 41-foot cut under the Union Pacific Railway, near Granger, had to be constructed.

In constructing the culvert piles of 65-foot length were driven through the center portion of the fill in order to reduce vibration from passing trains and protect the construction work itself. As the excavation progressed sheeting was placed behind the piles and cribs were constructed on either side. Material was removed by shoveling into steel dump cars which were run on a track to the end of the cut where the boom of a dragline excavator raised them and dumped the contents on the right-of-way.

Lagging was hand-driven to the lower lift, where volcanic ash, which is practically quicksand, was encountered. Water jet was used here and lagging was put into place by hand. Double lagging was necessary in order to prevent the water diverted through an old culvert from breaking through into the excavated area. The old culvert was 25 feet from the center line and 6 feet above the bottom of the culvert under construction. During the excavation of the last 8 feet a 5-inch and a 4-inch pump operated by electricity were used in diverting the water.

In the soft earth in the bottom of the trench gravel was placed considerably deep and on top of this a foot of concrete was laid. Concrete pipe, reinforced, and 4 feet in diameter, was placed on the concrete floor and the joints were cemented. Afterward a cradle of concrete was formed around the pipe where it lay.

## The Miniature Road Rollers of Belgium

BELGIUM is beginning to feel on her higways the strain of the motor truck. The roads on her national system are almost entirely of stone block laid on sand and sand-jointed. On account of the heavier traffic, when these roads are renewed concrete foundations are generally used and the joints are grouted. The older type of road had a life of from 15 to 20 years.

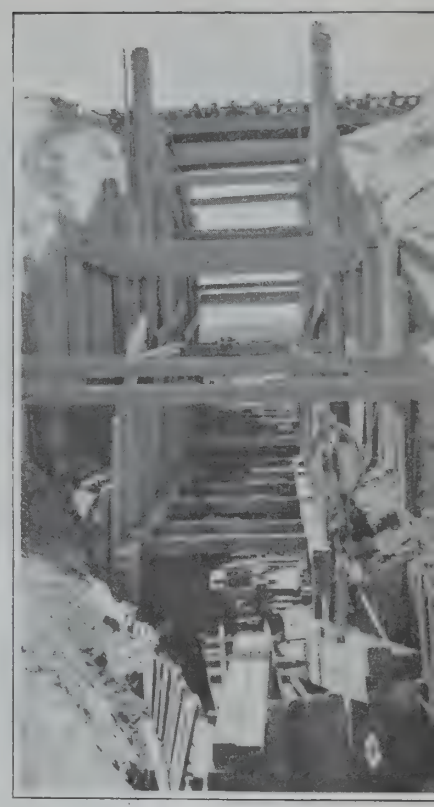
Some tar-macadam has been used, but on the whole stone-block construction is preferred. Just now, because of the shortage of block, considerable waterbound macadam is being laid as an emergency measure. Concrete has been laid only in experimental sections and conclusions regarding it have, apparently, not been drawn. For stone block, porphyry is preferred, except on grades where a hard sandstone, called *grès*, is used. The latter is gritty and gives a better foothold than porphyry.

A Belgian road-roller driven by a gasoline engine

The accompanying illustration, for which we are indebted to *Engineering News-Record*, shows a small road roller employed on Belgium highways. This machine is driven by a gasoline engine on the shaft inside the roller, and is steered by the smaller roller. The operator walks at the rear, with his hands on the control members at the end of a shaft.

## Impact Tests to Determine Highway Wear

THE Bureau of Public Roads of the Department of Agriculture has undertaken an important series of impact tests which are expected to establish in what degree motor truck traffic wears highways. These will continue over a considerable period of time. Statement is made that preliminary road impact tests indicate that the impact pressure exerted by a power truck in motion is about six times greater than that of a truck at rest.

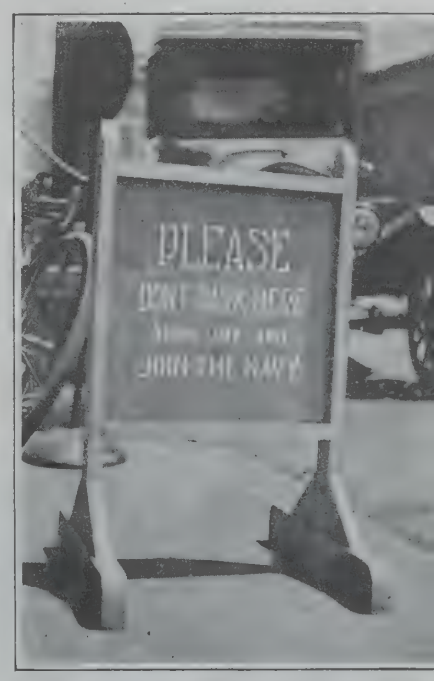


Looking through the excavation made for a draining culvert

The tests were conducted with a clas B Government truck loaded up to 5 tons running up to 15 miles an hour and al lowed to fall from varying heights o the impact measuring apparatus. Thes tests will be continued with trucks rang ing from the lightest weight to th heaviest until complete data is obtained The question of the relative impact ex erted by trucks with solid versus gian pneumatic tires will also be investigated

## A New Way of Advertising the Navy

WOODEN tablets, painted navy blue bearing the words, "Please don' park here. Shove off and join the navy, are now placing the iron "No Parking shields issued formerly by the polic department at Minneapolis, Minn. Thes signs are installed at the "no parking zones along the sidewalk in front o certain buildings. The same colore tablet, fastened to a post, is used fo a lawn sign on Government plots. Thi latter reads: "Please keep off th grass. If you want to roam, join th navy."—By *H. Lindquist.*




Minneapolis has found a new "no-parking" sign and Navy recruiting appeal combined

# Inventions New and Interesting

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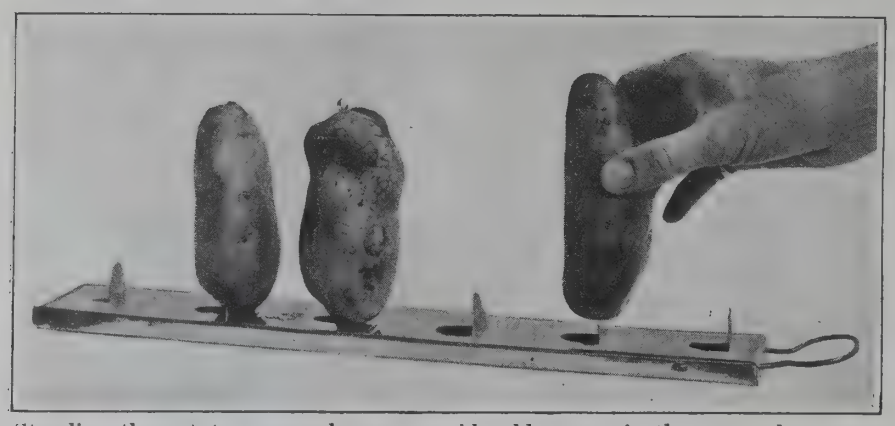


**Standing the potatoes on end saves considerable space in the oven when space is at a premium**

## An Idea That Saves Oven Space

IT is economy to have an oven dinner occasionally. And the potato baker shown in the above illustration takes up less oven space by baking the potatoes in a perpendicular position. The tin baker holds six fair-sized potatoes, all of them being removed at one time and without burning the hands.

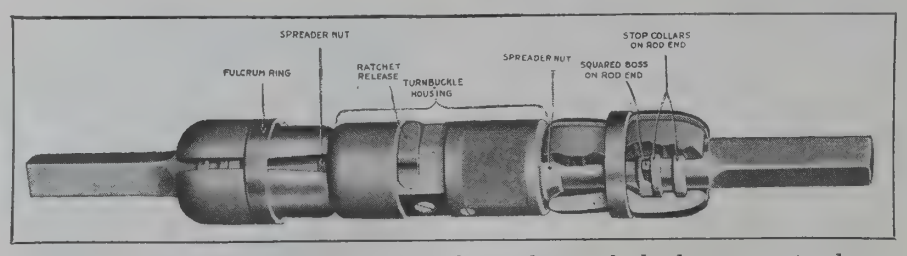
## A Step Forward in Coupling Drilling Rods

OWING to the unreliability and great loss of time involved in present practice, the joining of threaded male and female rod-ends has been a source of continuous annoyance to drillers and the men operating deep-well pumps.

However, by means of the newly-ented device herewith depicted a tight joint of sucker-rods or drilling poles can, within a few seconds, be accomplished in a reliable and more efficient manner than by the former way of screwing them together. And the latter was no easy task, considering that the lengths of rods and poles vary from 20 to 25 feet. This new rod coupling is constructed on practically the same principle as the hose coupling described in the SCIENTIFIC AMERICAN of June 5, 1920.

As may be seen from studying the illustration, a quick, tight and reliable joint can easily be obtained by allowing the squared boss-ends of the rods to slip into the squared sockets of the connecting shaft of the coupling, and by applying an ordinary wrench to the hexagonal recess of the turnbuckle-housing. The rods are, therefore, and without being turned, drawn together until their stop-collars are firmly seated on the stop-collars of the connecting shaft. The unscrewing of the turnbuckle during pumping or drilling operations is made impossible by means of a small ratchet inside of the housing, preventing same from turning backward, unless purposely released.

By the use of this new system of coupling invented by John Arthur Weis of New York City, rods can be lowered in a bore-hole or pulled in less than one-third of the time formerly needed, wherefore this style of coupling will be of greatest interest wherever poles or rods are extensively used, especially in deep well drilling and pumping.




**The new coupler for drill rods and sucker rods, partly broken away to show the coupling members**

**A slot in this tool permits of running oil between the spring leaves**

## A Handy Spring Oiler

THE oiler illustrated at the left has recently been patented. It is a most ingenious tool and will be found quite handy when working on an automobile. It is a combination oiler and wrench, and when used for the former purpose it is driven in between the leaves of the spring, preferably in the center. Its end is tapered, thus making insertion easy. Oil when applied runs down the grooved portion which is carried back about three inches from the tapered end, as shown.

## Moving a Bungalow by Motor Truck

WHEN the average citizen moves his home he hires a truck or a cart or wagon and several experienced able-bodied furniture manglers to do packing and loading and unloading and setting up, and confidently expects that at least half of his property will be serviceable when he is "settled." This is because the average house is owned by others or is too weighty or bulky to be taken along with the furniture.

But seemingly the ideal removal was made a short time since by a San Diego, Cal., resident, who was dissatisfied with his location. He bought a property four miles distant and because his bungalow suited him perfectly he wanted to set this up on the new lot. Removing it appeared difficult, but an enterprising truckman decided it was a practical undertaking. The building was mounted on wheels and with a big truck it was hauled over the road in six hours. From this it is evident that the bungalow has advantages that largely compensate its disadvantages when one wishes to move from one locality to another.

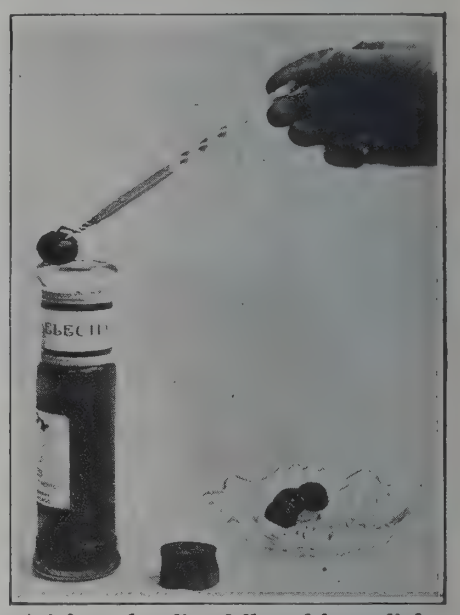
## A New Kink in Olive Forks

ONE of the simplest olive forks yet brought to our attention is that illustrated at the right. On the end of a long handle are two prongs, one of which is straight while the other is slightly curved. By piercing an olive with the straight point and giving the handle a slight twist, the curved prong catches the olive and prevents it from falling back into the bottle.

## Taking the Dirt and Trouble Out of Small Power Plants

A SELF-CONTAINED electric lighting plant that has the appearance of a piece of steel furniture, together with a highly-finished cabinet to house the battery, the combination adding to the appearance of any home, yacht, or wherever it may be placed, has just been brought out. It puts to shame the unsightly, oil-bespattered engines and open, dust-littered battery cells that are so common.

But, in addition to the appearance of the new electric unit, it employs what is undoubtedly the most handy feature ever used in a lighting plant. This is called the "Control Case"—a drawer which contains all of the vital electrical mechanism, instead of the usual multiplicity of meters, fuses, switches, etc., mounted on an open board. This "drawer" slides in and out the same as a drawer in any table or desk. If any trouble occurs one simply pulls out this drawer and slips another in its place, and the trouble is ended.

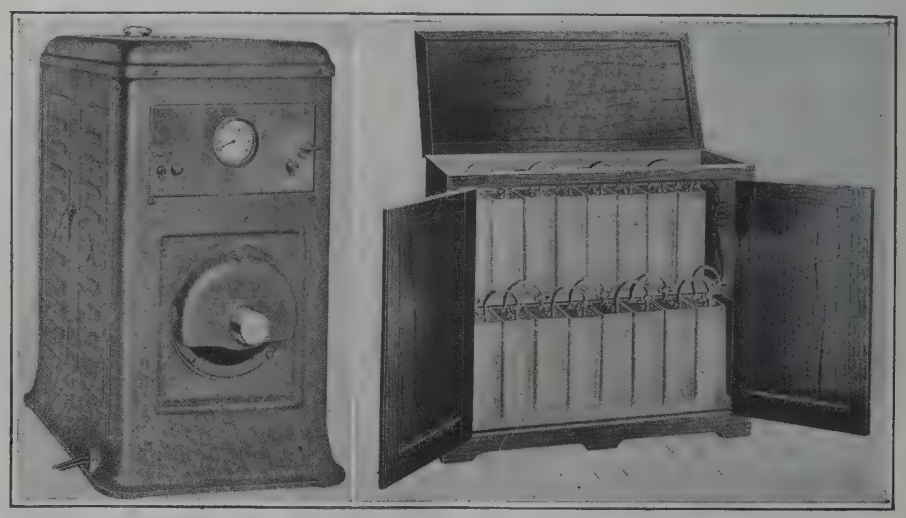


**A jab at the olive followed by a slight twist does the trick**

## Heating Dwelling Rooms with Acetylene

WE learn from the Bulletin of the Swiss Acetylene Society that the heating of dwelling houses by means of acetylene instead of coal is being strongly urged because of its great economic advantages. Enthusiasts, indeed, declare that we are about to enter upon a new period of domestic heating. Less service is required to handle the furnace and the time required for heating the building is less. In the Palace Hotel at Lausanne, a central heating system making use of acetylene has been in operation for several months, and is said to give great satisfaction. The building consists of a block of five houses, and to secure a temperature of 10° C. or 50° F., 400,000 calories are required, which requires the combustion in the middle of winter of 800 km. of coal per day. In mild winter weather this hotel can be kept very comfortable by the daily consumption of from 100 to 200 km. of carbide.

The acetylene is produced in a stationary acetylene apparatus mixed with air, and burned in a coil system. The entire hot water system to serve the five houses can be heated in 20 minutes to a temperature of from 70 to 80° C. or 158 to 176° F. Satisfactory precautions for entire safety of operation are of course fully guaranteed.



**Two cabinets of steel contain the engine, generator, and storage battery, thus eliminating dirt and trouble**

# Opening the Shortest Pathway to the Brain

IT is the prolonged dusk of Arctic night one hundred miles above the Circle—the thermometer far below zero and snow piled mountains high. A crowd of unlearned but eager Lapps, too numerous for the small mission chapel nearby, are assembled in the open air on skis and snowshoes—their eyes centered on a crudely erected screen of snow.

Across this screen, as white as Nature can make it, flashes a succession of vivid pictures—Japan, China, Korea, tropical India, all imaged on that Arctic background—pictures of climes and peoples that benighted audience had never dreamed of. And the source? A simple but efficient little stereopticon, the Balopticon, mounted on a rough table in the snow and covered with a heavy, protecting blanket, that its lenses may not break in the frigid atmosphere.

This true incident is perhaps unusual, but no more significant than countless other instances of Balopticon service. Optical projection has broken down the travel barriers to a knowledge of the earth. Photography and projection co-operating bring the world to our feet, for whatever can be photographed anywhere can be projected in life-like reproductions anywhere else.

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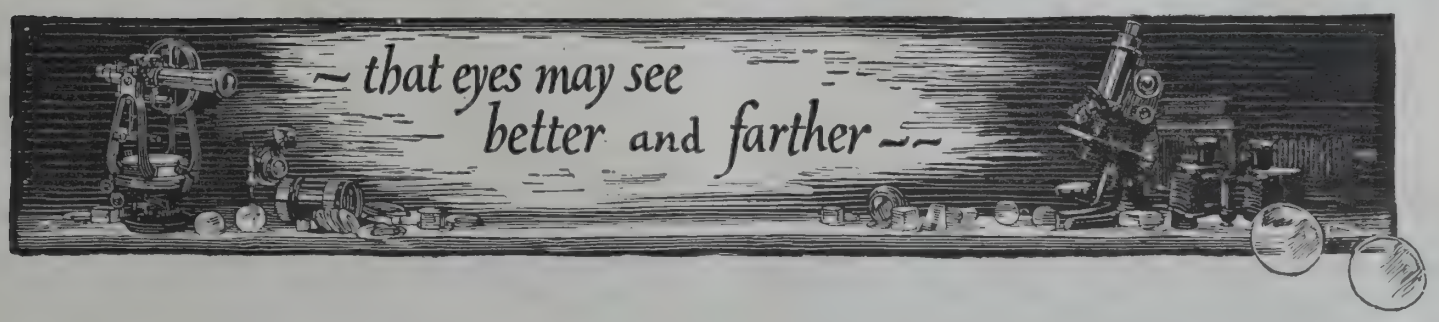

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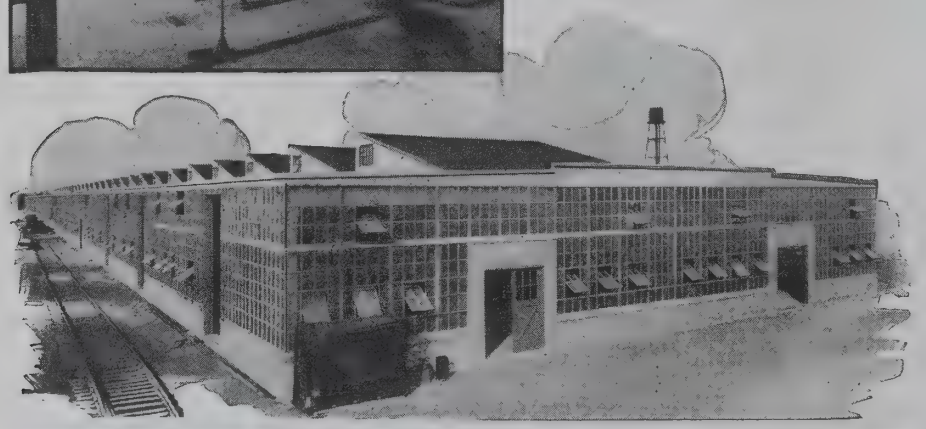



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## Our Lagging Gold Production

(*Continued from page 628*)

closing down. The principal causes of decline in gold mining in this country are the high wages, the decreased efficiency of that labor and the great increase in the cost of supplies. Since the outbreak of the war, prices of all commodities have increased greatly except that of gold, which as the standard of value is fixed at $20.67 per ounce. In other lines of activity where the cost of production increased the manufacturer could raise the price to be paid for his particular product to meet the excess cost, but the miner could only obtain $20.67 for an ounce of gold, even though the cost of producing it had doubled. Under the circumstances many mines have been compelled to close and await more favorable conditions. Those mines that have continued operations have been able to do so only by practicing the most rigid economies and by the curtailment of development work. The increased freight rates and car shortage have seriously interfered with the production of those mines compelled to transport their ore by railroad to distant smelters, and in the case of the dredging companies in California and Oregon the shortage of electric power has been so great that they were compelled to suspend operations entirely for several months in the summer or "dry" season, or else to operate under a decreased schedule, which raised their operating costs to a point where it was no longer possible to mine at a profit. Many dredges have been started in districts where the successful operation of the boat depends primarily on low running costs, and a large yardage, for there is only a certain value in each cubic yard of gravel and it must be extracted at a cost below that value if a loss is not to be sustained. The adding of a cent or two to the cost of handling a cubic yard of gravel often wipes out the margin of profit. Many of the smaller dredging companies found it necessary to shut down their operations, but the big ones, running a number of boats, find it so necessary to keep their trained men together that they cannot afford to suspend, and these companies have continued producing gold at the expense of greatly diminished profits.

To meet the situation confronting the gold miners in the United States a number of suggestions have been made for protecting them against adverse economic conditions. It has been suggested that a bonus per ounce be given to gold producers until such time as economic conditions will return to normal. The American Mining Congress and many other public organizations have adopted resolutions calling upon the Government to pass some legislation favorable to the mining industry, but to date these plans have not passed beyond the talking stage.

In connection with the suggested bonus on gold it is interesting to note that the same subject is being brought to the attention of the authorities in South Africa and Australia, and is now under discussion in England. The British Government has appointed a committee of experts to make a sweeping inquiry into the conditions at gold mines and to suggest possible measures of relief. Especial attention is being given the desirability of granting the demands of the gold producers for a revision of the selling price of their product to compensate for the increased cost of labor and supplies, to means of encouraging the mining of low-grade ores, and of stimulating the production of gold in general. According to a statement issued by the Chairman of the Transvaal Chamber of Mines, out of 46 companies operating in the Transvaal, 6 were running at a loss and 15 were barely paying expenses, and it is said that a large number of the mines on the Rand will have to shut down unless given some relief.

## The North Platte Project Today

(*Continued from page 629*)

after the river flows eastward a hundred miles or more to the land just opened for settlement the average elevation in the vicinity is about 4,100 feet above the sea-level. The stream was naturally a turbulent one and subject to enormous fluctuations in flow. At one time, there would be a devastating flood; at another, the old settlers would have difficulty in getting enough water to keep the crops alive. The excess water of the one season, though needed later on, simply went to waste. The lands now under irrigation had a normal value of about $1.25 per acre and served principally as grazing land over which cattle and sheep roamed with their attendant keepers. Now, the irrigated ranches are bought and sold at $150 to $200 per acre, and have a rental value per acre per year of $15 to $25. These are not land-boom values, but prices paid by one experienced settler to another. The sugar beet crop totals about $1,000,000; the potato crop another $1,000,000. Alfalfa attains a value equal to both combined. Wheat, oats, barley and maize are regular standard products. The country is so well-to-do that "automobiles on the country road are so thick that speed laws are unnecessary." It is claimed, in fact, that the agricultural value of these lands is probably as high as that of any other section in the country, with the possible exception of the fruit districts of California, Washington and Oregon. So, then, the cow and sheep country has not been turned into land that is moderately valuable, but into land that is comparable with the best there is.

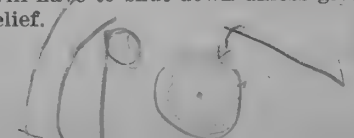
The North Platte project is a one-river enterprise. That is, it involves only a single general watershed. Naturally, minor rivers and streams tributary to the main river are to be included. The irrigated district lies partly in eastern Wyoming and partly in Nebraska. Near the boundry line between the two States, a subsidiary dam was placed. This structure is a diversion dam. The result has been a connection with two of the largest canals in the West. Each is 125 miles long and serves, or will serve, 100,000 acres.

The temperature in the various parts of the irrigated district naturally varies because of a difference of conditions. However, in the Fort Laramie region at an altitude of three-quarters of a mile, the mercury goes down to 30 below and up to 104 above zero, F. The irrigation season runs for six months, beginning April 1. But canals may have to be operated in winter time for other reasons. Thus, the Lingle Power Plant in Wyoming depends upon Platte water for its operation, and the City of Torrington depends, in turn, more or less upon this plant for lighting current. Naturally, such demands require winter operation of canals. The daily average of current supplied, in winter, seems to be around 700 kw-hrs.

## How Hard Is a Rock?

(*Continued from page 629*)

The grip containing the specimen is then removed, brushed free from dust, and weighed. By the use of small metal washers, one or more of which may be slipped over the projecting rod of the grip, the initial weight is adjusted to exactly 1,250 grams. Forthwith, the grip is replaced in the same position as previously and the machine given 1,000 revolutions, 30 to the minute. The material is again weighed, the tests being repeated with specimens reversed as a method of ascertaining the average hardness of the two ends. The one-fourth inch opening in the funnel of the hardness machine will consume 18.5 pounds of sand during the test. The coefficient of hardness for varying types of rock will range from 19.7 for the hardest specimens of quartzite to 0 for extremely soft limestones and sandstones.



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## Why the Cliff-Dwellers Vanished

(*Continued from page 630*)

change of work. Under primitive conditions all of this was wanting and it is, therefore, a safe assumption that the disastrous consequences of dust inhalation have been one of the most important contributory causes of an excessive death rate, leading ultimately to race extinction.

Without enlarging for the present purpose upon further details, it is sufficient to have emphasized one of the possible additional reasons, not heretofore advanced, why this ancient civilization should have come to an end. How large that population was is now, of course, but a matter of mere conjecture. According to Prudden, there is no reason for believing that the number of rooms in any district affords an exact indication of the populousness of the region at any one time, because the present condition of the ruins seems to point to very great differences in age. When the Old North Pueblo of Pecos was discovered by Coronado in 1540, it was described as to contain from 2,000 to 2,500 inhabitants. By 1797 the population had decreased to 89, which by 1838 had been reduced to a remnant of only "a dozen or so." (P. 38, Archaeological Institute of America.) It might be possible by estimates based upon the number of rooms in this ruin to arrive at some conclusion as to the probable density of population at a period when, however, the true cliff-dwellers had probably long been extinct. The South House at Puye, described by Morey, contains 173 rooms, which, assuming four persons to a room, would give about seven hundred inhabitants. But it is impossible today, due to destruction and decadence, to estimate with accuracy the probable number of rooms used for residential purposes, and nothing, of course, is known as to the approximate number of inhabitants.

If there is so much uncertainty as to the number of ancient inhabitants, there is somewhat less doubt as to their bodily proportions. Unfortunately, far from enough has been made of the skeletal remains that have been discovered and over-emphasis has been placed upon cranial measurements, much less important than bodily proportions for really practical purposes. Morey in his report on the "Cannon-ball Ruins in Southwest Colorado" describes three entire skeletons, assigning to the femur a proportion of 27 per cent of the entire length and determining the stature of the three at 5 ft. 2 in., 5 ft. 3 in., and 5 ft. 4 in., respectively; or all under 5 ft 6 in., and while he admits that these values are probably a little low, he remarks that "even discounting the slight shrinkage which invariably takes place between the living body and the skeleton, the heights thus attained are approximately low." This conclusion seems justified in the light of other measurements, all indicating that the average stature of the builders of these structures was "considerably below that of our own race"; and this is true also for the Pueblo, Zuni, and Hopi Indians of today.

Without, therefore, arguing the question as to the probable numbers of the ancient population and the rate of decadence during the historic period as possibly deter-

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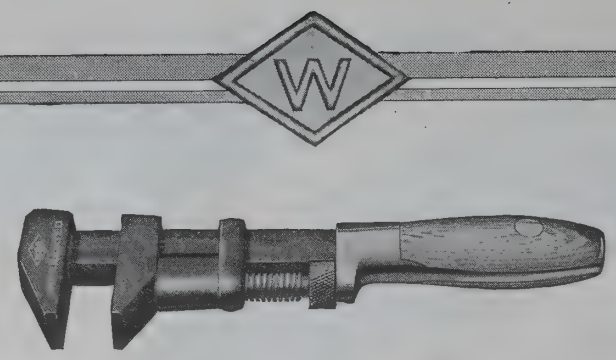

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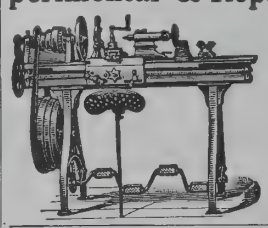

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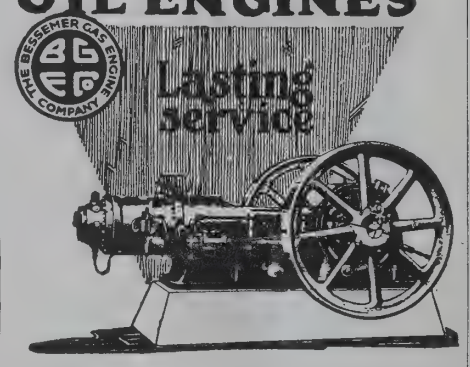


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mined by existing ruins, it would seem that the conclusion is justified by the known facts, that this population was quite extensive, but at the time of its decadence, below average stature, possibly indicative of undernourishment, which, with the indicated continued exposure to health-injurious dust, would lead to the further conclusion that an excessive mortality rate, more probably than any other extraneous cause, gradually led to an excess of deaths over births, and a vanishing population, of which the remnants found shelter and new homes among the Pueblos farther to the south, possibly as far as northern Mexico.

This conclusion, which as far as I know, has not heretofore been advanced, is also supported by another fact of not inconsiderable importance. The extensive and unusual development of the pottery industry among these people also represents a dusty and health-injurious occupation, which under given conditions would be certain to prove detrimental to life and health. The subject is, therefore, one well worth further consideration and it is hoped that these suggestions may at least result in the scientific ascertainment of the nature of the stone materials manipulated by these ancient people and particularly the chemical and microscopical characteristics of the stone work and masonry, typical of the so-called cliff-dwellings, varying widely, of course, according to the geological formation from southern Colorado and Utah to southern New Mexico and Arizona.

## Disposing of the Sewage

(*Continued from page 632*)

cance of efficient spraying and delivering the sewage in fine showers to trickle through the interstices of the beds and carry fresh supplies of oxygen to sustain aerobic conditions. The beds, otherwise, are apt to become clogged and ineffective.

When, in 1909, the filter beds of the Mount Vernon Works were ready, repeated trials were made of various sprinkling devices in use elsewhere, especially of the cups used at the Experimental Station of Massachusetts. These latter contrivances gave the best results, but it was not until Mr. Boyd Wilkie, now superintendent, devised a cup with a rolled rim, that nearly perfect results were obtained. This cup of rolled metal, three inches in diameter, one inch deep, with a rolled rim, is socketed on a standard eighteen inches high to receive a stream from a ¾-inch nozzle at an elevation of about five feet. Exhaustive experimental tests (*Engineering News*, March 24, 1910) were made, finally giving 92 per cent efficiency in overlapping areas of spray. The secret of the efficiency of the cup is the rolled rim which spreads the spray evenly, over a greater circumference of area than a cup with a sharp edge, and in finer spray.

When the building of the plant was under discussion and before a final decision was reached, in order to satisfy property owners and residents in its vicinity, the engineers were obliged to devise a ventilating system to carry off noxious odors which, in ignorance of the efficiency of properly constructed filter-beds, the public imagined, would be insufferable.

So, at an unnecessary expense of some thirty thousand dollars, twin towers were erected, supplied with electrically-driven fans to draw off, through a system of drums, the noxious gases from the filter sheds and scatter them in the upper air. Of course, there was no appreciable odor beyond the immediate vicinity of the works to be overcome in any such ridiculous way. The device has never been used. The contractors derived the sole benefit of the extra expenditure. At a distance of a hundred yards from the works, no odor is perceptible.

The grounds about the works have been graded and made into the semblance of quite an attractive park and as there are many shade trees on the surrounding terrace, visitors are not loath to take advantage of a rest on park settees provided for their convenience.

## A New American Industry

(*Continued from page 634*)

ingenuity has not been latent in the design of these toys and sales on some recent models have reached enormous figures.

The German toy industry will undoubtedly recover, in a measure, from the paralysis it suffered during the war. But a very different class of toys will have to be sold in this country. There were a few large toy factories in Germany before the war but the backbone of the German toy industry was the individual workman who made toys in his own home, often being assisted by the entire family, marketing his goods through a syndicate. The art of the toy-maker was handed down from father to son through many generations.

The workmanship of these home toy factories is exquisite and it cannot be equaled on a quantity basis. Nor has the American workman the patience to produce such toys at any price. If German labor conditions return to normal, undoubtedly her home toy producers will again be a factor.

As an example, there were recently imported from Germany by a large toy dealer five large models of a great ocean liner. They were perfect in every detail and although they sold for $150 each, they were gone within a few days after being placed on display in New York. The boats could not have been made for that sum in this country.

The situation of our new toy industry is effectively summed up by a New York toy merchant and manufacturer in these words: "Before the war I would have believed it impossible to get along without the German toys. They were the backbone of every toy display. The few American toys were rather shabby and they were just 'fillers' in the line. I tried for years to put a line of American-made mechanical toys on the market without success simply because the toy buyers would not give the line a chance. That was just the trouble. It wasn't that we were not able to make toys as well as anyone else, but that no one would buy them. The war gave us the chance and we have never missed the German toys from our shelves. There will be some toys imported, we may be sure, but the foreign toys will occupy about the same place in our market that the domestic toys used to hold."

## The Properties and Uses of Manjak

(*Continued from page 635*)

ular efficacy in keeping such pipes watertight, air-tight, and free from corrosion at the joints, but it also facilitates the work of joining and separating the pipes owing to its lubricating qualities. It has been found much superior to white lead or any other substances previously used for such purposes, and its use results in economy.

The Government of Trinidad is now making use of manjak in painting the under parts of bridges and other structures where protection is required from water. Excellent results have been obtained by using manjak paints and compounds on steel smoke stacks, car trucks, fenders, burrers, and all iron and steel work connected with power-house and car buildings. Their compounds have also been used successfully in the form of insulating varnish on armatures and electrical connections, and on car roofs as a protection from the hot, tropical sun and rain. In general, where a good insulating material is required against heat or electricity, the value of manjak is said to be exceeded only by rubber and glass.

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